MILITARY PAY POLICY AND THE EFFECTS ON AIR FORCE REENLISTMENT

By

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Abstract of Dissertation Presented to the Graduate School
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MILITARY PAY POLICY AND THE EFFECTS ON AIR FORCE REENLISTMENT

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This dissertation analyzes military pay and retention. The study explores the distributive effects from a 1998 policy, which changed the methodology for computing military housing allowances. Additionally, the study analyzes the local labor market wage effects on Air Force first-term reenlistments. Finally, an alternative wage structure is proposed to replace the housing allowance system.

First, the study analyzes the effects of the 1998 policy change in computing military housing allowances to determine if the policy met Department of Defense's (DoD) goal of creating equity. Results show that housing allowances increased in most locations and ranks, but significant differential policy effects were evident. Some of these effects were expected. However, increased allowances in locations voting Democratic in the 1996 presidential election cannot be reasonably attributed to the DoD's goals. Estimates for allowance increases associated with a 1 standard deviation increase from the mean in the % Democratic vote ranged from 0.99% to 3.42%.

Next, the study compares the differences in military and civilian wages across locations and estimates these differential effects on Air Force reenlistments. Results show that military wages are not in equilibrium with local civilian labor markets. The cost-of-living elasticity of military wages is significantly less than that for civilian wages;

and military wages are not adjusted for location amenities. The result is an inequitable distribution of military wages across locations. This inequity was shown to significantly affect the reenlistment decision of Air Force first-term personnel from 1996-2001.

Finally, the study proposes an alternative wage structure to replace the current system. Analysis shows that the current system leads to production inefficiencies caused by short-term manning shortages in excessively high-turnover locations. Additionally, because wages are not set at the level required to induce enough volunteers to serve in each location, the total opportunity cost for personnel serving is not minimized. The solution is to set military wages according to the local civilian compensating wage differentials. Wages set accordingly would result in a more stabilized force, by equalizing the opportunity costs at each location. Simulations show that the proposed wage structure would better equalize reenlistment rates across locations, and this could be at no cost to the government.

CHAPTER 1
INTRODUCTION

Military pay and compensation is an essential element to maintaining an effective and efficient fighting force for the United States. Numerous policies have been implemented over the past decade to improve compensation for our nations' military personnel. Specifically changes have been made in attempt to create equity of wages across geographic locations as well as improve the competitiveness of military to civilian wages. This study explores the distributive effects from a 1998 policy, which changed the methodology for computing military housing allowances. Additionally, the study analyzes the local labor market wage effects on Air Force first-term reenlistments. Finally, an alternative wage structure is proposed to replace the housing allowance system.

First, I analyze the effects of the 1998 policy change in computing military housing allowances to determine if the policy met Department of Defense's (DoD) goal of creating equity. I also examine whether a political bias associated with the implementation of this government program is evident in the distribution of allowances. Allowances are examined according to 1996 presidential election results to test this hypothesis.

Next, the study compares the differences in military and civilian wages across locations to determine if local labor markets play a significant role in the reenlistment decision. First-term reenlistments for the Air Force from FY96 through FY01 are analyzed by occupation and location. Results show that military wages, when compared

to civilian wages, are not fully adjusted for the cost of living and amenity differences across locations and this lack of adjustment significantly impacts retention. Evidence suggests that retention could be better optimized by further adjusting wages for local labor market conditions. Additionally, further analysis suggests that the disequilibria of military and civilian wages may affect the quality of personnel who reenlist at each location.

Finally, I analyze the current military wage structure and showed why the system pays an inequitable and inefficient wage across locations. Additionally, an alternative wage structure is proposed which yields a more equitable and efficient wage. The proposed wage structure would lead to a more geographically stabilized force, while lowering moving costs and potentially increasing retention. Wage estimates are calculated using the proposed wage structure and retention effects are simulated on first-term Air Force reenlistments from 1996-2001. Simulations show that the proposed wage structure would better equalize reenlistment rates across locations, and this could be at no cost to the government.

CHAPTER 2
EMPIRICAL ANALYSIS OF THE DEPARTMENT OF DEFENSE MILITARY HOUSING ALLOWANCE PROGRAM

Active duty service members not residing in government-owned housing[1] are given additional compensation to help cover their personal housing costs. Housing allowances vary by location, rank, and dependency status[2] and are computed for approximately 370 locations throughout the United States. This program accounts for nearly $6.5 billion of the Department of Defense's (DoD) annual budget, with over 710,000 service members receiving housing compensation.[3]

In the mid-1990s, the DoD re-examined the methodology used to compute housing allowances because rates were thought to be inequitable. In general, compensation was believed to be inadequate in high-cost locations and for low-ranking members. For these reasons, in 1998, the DoD changed its policy for computing allowances. The goal of the new system was to create geographic equity of allowances, enabling all service members to live in adequate housing regardless of duty location.[4]

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[1] Government-owned quarters are provided at no personal expense to service members on a limited basis. All other members are given a housing allowance for private residences.

[2] Dependency status refers to whether or not the active duty member provides support to members living in his or her residence (i.e., spouse or children).

[3] Budget and service member figures do not include the US Coast Guard (U.S. Office of Management and Budget, 2001).

[4] The DoD has set housing standards based on rank and dependency status. These standards vary from a 1-bedroom apartment for the lowest ranking members without dependents to a four bedroom single family home for senior officers with dependents.

[5] The DoD's policy change was phased in starting in 1998 with full implementation in January 2000.

The purpose of this study is to analyze the effects of the DoD's policy change in computing housing allowances. Allowances are examined before and after the change to determine if the policy met its intended objective of creating equity.[5] I also examine whether a political bias associated with the implementation of this government program is evident in the distribution of allowances. Allowances are examined according to 1996 presidential election results to test this hypothesis.

Housing allowances are analyzed in three ways. The first analysis examines the total change in the housing allowance throughout the policy implementation by rank and location to determine the overall effects from the BAH policy. Allowance increases from 1996 to 2001 are regressed as a function of the changes in rental costs, a pre-BAH inequity measurement, and other explanatory variables. The second analysis examines allowances on a yearly basis to determine how allowances were differentially affected by the policy. By analyzing a 6-year panel of housing data, the model is able to control for unobserved variation by location and rank. Additionally, this model compares allowance changes throughout the policy implementation. Finally, housing allowance changes from 2001 to 2002 are examined to see if there were any remaining effects after the BAH system was fully implemented.

Motivation for this study stems from the broad economic impact the housing allowance has on our nation's military personnel. Total compensation for junior enlisted personnel ranges from $20,000 to $25,000, with the housing allowance accounting for a substantial portion of this income. Additionally, housing expenditure for an individual's residence can be interpreted as a type of savings, with the amount of the allowance significantly affecting the magnitude of the savings (i.e., size and quality of the

residence).[6] Finally, housing allowances can have a significant impact on local economies in which a large number of military personnel reside.

Political Parties and Distributive Politics

As far as I can tell, this is the first empirical analysis on the military housing allowance program. However, extensive research exists on the politics of federal spending programs.

Several models exist for the role of political parties in distributive politics. A first model views political parties as relatively weak organizations and suggests that distributive politics exist at the committee or representative level. This first model suggests that districts with powerful representatives may be favored. Another theory, called the strong party model, predicts that the party that controls the government can target spending to a particular program and/or district. The strong party model assumes that the controlling party acts in unison to maximize a mix of policy and election goals (Levitt and Snyder, 1995). However, little empirical evidence supports this model in the United States.[7] A third model views political parties as groups that sometimes work together to achieve a goal, but cooperation is limited because of conflicting preferences. Under this model, parties who control a majority for an extended period of time may be able to "fashion a portfolio of programs that disproportionately favor its constituents" (Levitt and Snyder, 1995 p.962). A final model predicts policy outcomes from an agenda-setter game between the president and Congress. That is, a president seeking reelection sets an agenda in which he seeks to favor swing states. Congressional

[6] This is only the case when the individual owns the house.
[7] This is because the Executive and Legislative branches of government have rarely been controlled entirely by one party.

approval of this agenda is more easily accomplished when the "president has a greater ability to influence the reelection prospects of the legislators" (Fleck, 1999 p.378).

The hypothesis for political influence with the BAH program fits the "strong party" model, but only from a presidential perspective. The BAH program was designed and implemented within the DoD (i.e., the executive branch) and then voted into law by Congress. The hypothesis for political influence stems from the fact that presidential political appointees control the DoD and, hence, controlled the implementation of the BAH program. Congress probably did not play a key role in determining housing allowances because the BAH program was voted into law as a part of the entire National Defense Authorization Act of 1998. Section 603 of House of Representative Bill 1119 authorized the Secretary of Defense to determine the amount of the housing allowance. The language of the bill stated, "The Secretary of Defense shall determine the costs of adequate housing in a military housing area in the United States for all members of the uniformed services entitled to a basic allowance for housing in that area. The Secretary shall base the determination upon the costs of adequate housing for civilians with comparable income levels in the same area."

Numerous empirical studies have examined the role of politics in U.S. Federal spending. Whicker and Giannatasio (2000) examined total Federal Military Spending at the state level, as well as recommendations made by the Defense Base Closure and Realignment Commission (BRAC) for 1991 and 1993. The most important factor for both spending and BRAC decisions were membership on key House committees (i.e., Armed Services, Appropriations, and Budget committees). Levitt and Snyder (1995) examined federal spending on a per-capita basis for 1984-90 and found that the number of Democratic voters is an important predictor in determining per-capita spending of

federal dollars. They showed that Federal assistance programs across districts are an increasing function of the number of Democratic voters in a district. Programs with formulas are more heavily skewed toward Democratic voters than programs without formulas. Additionally, high variation spending programs with a geographically concentrated distribution of benefits (i.e., highway construction, food stamps, education grants) tend to favor Democrats more than do low-variation programs with a broad geographical recipient base (i.e., social security, Medicare, and military retirement benefits). Their results showed a Democratic voting increase from 50% to 60% resulted in an 18% increase in per capita spending for high-variation outlays and a 5% increase in low-variation outlays. Finally, their analysis showed that political control of the Legislative and Executive branch at the time of program initiation plays an important role. "Programs initiated during the mid to late 1970s, when Democratic control was especially strong, exhibit the greatest bias towards Democrats, while programs passed in the Reagan era show little pro-Democratic bias." (p.973)

Atlas, Gilligan, Hendershott, and Zupan, (1995) showed that over-representation in the US Senate results in small states securing a significantly higher level of per capita federal net spending for their constituents. Browning (1973) showed that districts in 1970 that were represented by a Democrat were more likely to receive above-median levels of federal outlays than those represented by a Republican.[8] Finally, Owens and Wade (1984) found a small positive effect on district spending with increases in the % Democratic vote in the 1978 congressional election.

[8] Cited from Levitt and Snyder (1995).

Housing Allowance System

Before 1998, service members received two separate housing allowances: Basic Allowance for Quarters (BAQ) and Variable Housing Allowance (VHA). The BAQ was a flat rate paid to all members regardless of duty location. This allowance varied by rank and dependency status and was adjusted annually in concert with military pay raises. The VHA varied by location, rank, and dependency status, and was based on local housing surveys.[9] The year 1997 marked the final year that BAQ and VHA were paid to service members. These combined allowances ranged from $362 to $1,821 per month, depending on rank and duty location.[10]

The BAQ/VHA system encountered much criticism. First, annual increases in BAQ were tied to military pay raises, which lagged behind increases in housing costs. Over time, this caused increases in the out-of-pocket[11] expense for service members, as allowances covered less and less of housing costs. Second, there existed a "death spiral" of the VHA allowance. According to the DoD, "Low allowances forced members into inadequate housing, and they reported low costs on the VHA survey, which, in turn, drove the allowances further down."[12] This typically occurred among junior ranks. Conversely, the opposite effect is thought to have occurred among higher ranks. Those service members who could afford to pay for a higher standard of housing would then report this expenditure on the annual survey, thus causing an upward inflation of the allowances for that particular rank.

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[9] Members were required to submit the amount they paid for housing on an annual basis.
[10] These figures are for members with dependents in 1997. $361.50 per month was paid to the lowest ranking enlisted member living in Altus, OK. $1,821.21 per month was paid to a General Officer living in New York, NY.
[11] The Department of Defense considers out-of-pocket expenses to be the amount a member pays for housing (rent, utilities, and insurance) minus the housing entitlement received.

Geographic inequity was a further problem with the BAQ/VHA system. Members of the same rank had a wide array of housing standards and out-of-pocket costs depending on the location of duty. Generally, allowances were thought to not fully compensate for the higher cost of housing found in some locations. For these reasons, the DoD decided to overhaul the housing allowance system.

In 1998 the DoD implemented the new system called Basic Allowance for Housing (BAH). Like the BAQ/VHA system, BAH varies by location, rank, and dependency status. Unlike the old system, BAH is not tied to pay raises or personnel housing expenditures. Instead, allowances are computed using local housing costs. Rent, utility, and insurance prices are collected annually from each military housing area (MHA).[13] Median costs for all housing types are used to compute a rank-specific housing cost for each location.[14]

Because of funding constraints, the DoD currently does not fund 100% of the local housing cost for each rank. With geographic equity as the goal, a rank-specific out-of-pocket expense is computed using the national median housing cost for each rank. In 2000, the out-of-pocket expense was 19% of the national median housing cost. For example, in this year, the out-of-pocket expense for E-5s (Air Force Staff Sergeant) with dependents was $154 per month. The DoD's goal was that all E-5s would pay $154

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[12] From BAH FAQs (Defense Technical Information Society, 2001)

[13] MHA is a location for which housing allowances are computed. These areas have a high concentration of military personnel assigned or are a major metropolitan area.

[14] The DoD contracted the data collection to Runzheimer, International. Data are collected from newspapers, real estate agencies and base housing offices. Median housing costs are computed in each location for 1 and 2-bedroom apartments; 2- and 3-bedroom townhouses/duplexes; and, 3- and 4-bedroom single-family homes. These median housing costs are tied to specific ranks (e.g., 2-bedroom townhouse/duplex to E-6). Housing standards are based on minimum standards for civilian counterparts of the same salary. Local median housing costs for the other pay grades are determined using a nonlinear mathematical model.

out-of-pocket for an adequate 2-bedroom townhouse/duplex regardless of geographic location.

This methodology appears to have many advantages over the old BAQ/VHA system. First, BAH should eliminate the "death spiral" and high-rank bias, by taking out the influence of members choosing to live in various housing standards. Second, the new system should eliminate the creeping growth in out-of-pocket costs to members because housing allowances are no longer tied to military pay raises and are based solely on local housing costs. Finally, the BAH system should create geographic and pay grade equity. Because allowances are computed using actual pricing data, members of the same rank should be able to live in equal housing regardless of their duty location.

Although the BAH system was first implemented in January 1998, this was only a partial implementation of the system. Because of drastic changes in allowances for many areas (and because of funding constraints), Congress initially decided to phase in the BAH policy over a 6-year period. According to the DoD, "Transition methodology was designed to strike a careful balance; gradually increasing allowances in the locations where rates were higher, without the need to decrease payments to individuals in locations where BAH allowances were lower than they were in 1998."[15] However, in fiscal year 2000, Congress decided to speed the transition from 6 to 3 years, with implementation nearly complete in January 2000.

When the 2000 allowances were implemented, there were many changes to allowances, both positive and negative. The decreased allowances in some areas caused much outrage. Complaints were forwarded to senior military and civilian leaders. As a result, in March 2000, rates were restored to the highest of the 1999 or 2000 allowance.

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[15] From BAH FAQs (Defense Technical Information Society, 2001)

This action in effect caused a "truncation" of the BAH policy by not allowing negative changes to allowances after 1999.[16]

Currently the DoD is working to further improve the BAH system. The data-gathering process has been further scrutinized by local base housing offices to ensure that only "acceptable" housing data are included in allowance computation. Further, the DoD is committed to reducing the out-of-pocket expense for members to zero by 2005. For 2001 the out-of-pocket expense for allowance determination was 15% of the national median housing cost, and for 2002, it was 11.3%.[17]

Scope and Data

The scope of this study is to analyze housing allowances from 1996 through 2001 to determine the effects of the DoD's policy change from the BAQ/VHA system to the BAH system. Allowances are examined throughout the policy change to determine if fair market rents, local population, number of military personnel assigned to a location, rank, branch of service, and political voting patterns can explain the variation in the changes in allowances.

Dependent Variable

Housing allowances from 1996 to 2001 were used to construct the dependent variables for the analyses. Allowances were collected for ranks E-4 through E-9 (Air Force Senior Airman through Chief Master Sergeant) and O-1 through O-7 (Air Force Second Lieutenant through Brigadier General) for approximately 370 MHAs.[18] Ranks

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[16] The truncation action affected 2,652 of 4,810 allowances in 1999, 1,257 of 4,745 allowances in 2001 and 1,034 of 4,758 allowances in 2002.

[17] Information provide by the Office of Secretary Defense, Entitlements and Compensations.

[18] In 1998 allowances were computed for an additional 30+ locations called County Cost Groups. These data points were not computed using the same methodology used in computing the other allowances; therefore, these data were eliminated from the data set.

E-1 through E-3 were not used because these allowances are identical to those for E-4 after 1998. Without-dependent allowances were not used because of their high correlation to with-dependent allowances.[19]

The first analysis (Table 2-1) uses the % change in the allowance for each location from 1996 to 2001 for the rank of E-4 as the dependent variable. This variable was computed by taking the natural logarithm of the ratio of the 2001 to 1996 allowance. The second analysis (Tables 2-2 to 2-4) uses the natural logarithm of the housing allowance for all ranks and locations as the dependent variable. The final analysis (Table 2-5) uses the % change in the allowance for each location from 2001 to 2002 for the rank of E-4 as the dependent variable. This variable was computed by taking the natural logarithm of the ratio of the 2002 to 2001 allowance.

Changes in housing allowances varied considerably throughout this 6-year period, depending on location and rank. For example, variation by location is observed when comparing allowances at Minot, ND and New York, NY for the junior enlisted rank of E-4. In 1996 the allowance at Minot, ND was $390. It rose in 1997 to $408 and in 1998 to $419. However, in 1999 the allowance declined to $393 and remained at that level for 2000 and 2001. The overall impact of the DoD's policy change was negligible, with a modest $3 nominal increase over the 6-year period. New York, NY exhibits a quite different effect. The allowance in 1996 was $593. It rose considerably to $717 in 1997, with only slight gains over the next 2 years to $738 and $769. Large increases were observed during full implementation of the BAH system as the allowance rose to $937 in 2000 and to $1,315 in 2001. Overall, the allowance rose 122% during the 6-year period.

[19] A complete list of variables with summary statistics is located in Appendix A.

Variation by rank within a location is also observed in the data. For example, allowances for Amarillo, TX for the enlisted rank of E-4 and officer rank of O-3 (Air Force Captain) exhibit this variation. The allowance in 1996 for the enlisted rank was $390. It rose slightly each year during the next 3 years to $427 in 1999. Increases were considerable in the following years, with the allowance rising to $473 in 2000 and $549 in 2001. Allowances for the officer rank also increased, but to a considerably lesser extent. In 1996 the allowance was $639, with slight increases over the next 3 years to $686 in 1999. It remained at that level in 2000 and rose to $687 in 2001. Overall, the officer rank experienced significantly less growth (7.5%) than the increase for the enlisted rank (41%).

To explain variation in changes in allowances throughout the policy implementation, location- and time-specific explanatory variables are used in the analysis.

Explanatory Variables

Fair market rent (FMR)[20] for a 2-bedroom apartment was chosen to account for the variation in housing prices between locations. The FMRs are published annually by the US Department of Housing and Urban Development.[21] Rents ranged from $343 for Fort Campbell, KY in 1996 to $1,459 for San Francisco, CA in 2001. Also considered for this variable were local median housing prices published by the National Association

[20] Fair market rents are the pricing standards used in determining eligibility of housing units for the Section 8 Housing Assistance Payments Program. The current definition used is the 40th percentile rent (U.S. Department of Housing and Urban Development, 2001)

[21] If the MHA is located in a Metropolitan Service Area (MSA), the fair market rent for the MSA was used. If the MHA was not located in an MSA, then the fair market rent for the corresponding county was used. In a few cases, the county's fair market rent was not available, so the value for an adjacent county was used.

of Realtors. Fair market rents were preferred, because median housing prices were not available for a substantial number of MHAs.[22]

The first analysis uses the % increase in the FMR from 1996 to 2001 to control for rental cost inflation at each location. This variable was calculated by taking the natural logarithm of the ratio of the 2001 to 1996 FMR. The second analysis (Tables 2-2 to 2-4) uses the natural logarithm of FMR across all locations and years. The final analysis (Table 2-5) uses the % change in the FMR from 2001 to 2002. This variable was calculated by taking the natural logarithm of the ratio of the 2002 to 2001 FMR. Coefficients for the FMR variables in each analysis are expected to equal 1. That is, housing allowances should increase in proportion to increases in rental costs.

The first analysis uses the housing allowance and the FMR in 1996 to construct a "system adjustment" variable to control for housing allowance inequity under the old BAQ system. This variable was computed by taking the natural logarithm of the ratio of the FMR to the housing allowance in 1996. The coefficient on this variable is expected to be positive and significant. That is, housing allowances under the BAH system should have increased in locations that had a relatively high FMR compared to the housing allowance.[23]

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[22] For locations where data existed for both variables, the correlation between fair market rents and median housing price is .842. Analysis was conducted using a subset of data containing median housing prices. Results did not vary significantly from results using fair market rents.

[23] The coefficient for the adjustment variable should be close to 1 for the rank of E-4, where the DoD housing standard is a 2-bedroom apartment. The variable should only equal 1 for the other ranks if there is a linear relationship between rental costs for a 2-bedroom apartment and rental costs for larger-size dwellings. However, regressions of the number of bedrooms on FMRs for studio, 1, 2, 3, 4 bedroom apartments in 2002 show a positive quadratic fit for the number of bedrooms. The nonlinear relationship indicates that error in this measure increases with increases in housing standards.

The natural logarithm of the local population[24] is used as an explanatory variable to see if the population of the MHA affected the adjustment in the housing allowances. Population may have a significant positive influence on allowances because of the methodology of the DoD's data collection process. First, in highly populated areas is it much easier to identify locations where military personnel reside and to eliminate substandard housing units not suitable for military members. Sectoring off substandard housing areas is a relatively easy task, because suitable and unsuitable housing subdivisions are typically located in relatively defined areas. On the contrary, eliminating unsuitable housing from MHAs with a relatively small population is a dubious and sometimes impossible task. Housing standards in rural areas can vary greatly within a small area, which may allow unsuitable rental properties to be included in the data, thus causing a negative bias.[25] Therefore, the coefficient on the population variable is expected to be positive.

The natural logarithm of the number of military personnel assigned to an MHA was chosen as an explanatory variable because areas with a high number of military personnel assigned typically have a military housing office aiding in the data-collection process. Starting in 2000, military housing offices were permitted to eliminate data from properties that they determined to be unsuitable. Since housing offices only exist where a

[24] Using the 1990 and 2000 census, population was assumed to grow/decline linearly during these periods in order to generate year-specific populations for each MHA. If the MHA resided within an MSA, then the population for this MSA was used. If the MHA was not located in an MSA, then the population for the corresponding county was used (U.S. Census Bureau, 2001).

[25] A positive bias could also exist, but this is highly unlikely, as large expensive homes above military standards are typically not available for rent. The negative bias was found to exist in the data used to compute the 2000 allowances at Seymour Johnson AFB located in Goldsboro, NC, with a county population of 113,000. A more extensive study is needed to verify if this patter was a widely observed in other rural MHAs.

large number of military personnel are assigned, this may cause housing allowance changes to increase with the military population.[26] Therefore, the coefficient on this variable is expected to be positive. The number of military personnel assigned to each MSA ranged from 17 in Pittsfield, MA to over 60,000 in Norfolk, VA.[27]

To determine if politics had an influence on allowance changes throughout the policy implementation, the natural logarithm of the local[28] % Democratic vote in the 1996 presidential election is used as an explanatory variable. The 1996 election was chosen because the DoD's policy change was adopted and implemented after this election.[29] A positive presidential influence is hypothesized because of the large number of high-ranking political appointees working in the DoD.

Finally, dummy variables for the dominant branch of service (i.e., Army, Navy, Marine Corps, Air Force, and Coast Guard) are used as explanatory variables to determine if the policy change affected each branch of service differently. With equity as the DoD's goal, the coefficients for these variables should equal zero. Appendix A, Table A-1 gives a complete list of all variables used in the analysis.

Methods and Results

Change in Allowance Analysis

To assess the overall effects of the BAH policy change, analysis is conducted on the total change in allowances from 1996-2001. This analysis uses a linear spline regression model with the following format:

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[26] For this reason, a selection bias could occur depending on whether or not the MHA contains a military housing office; and depending on each housing office's interpretation of "unsuitable" housing.

[27] Eleven of the 370 locations were missing data for this variable.

[28] If the MHA is located in a Metropolitan Service Area (MSA), the % Democratic vote for the MSA was used. If the MHA was not located in an MSA, then the % Democratic vote for the corresponding county was used.

$$\Delta Allow_i = \gamma Inflation_i + \delta Adj1_i + \phi Adj2_i + \beta X_i + \mu_s + \varepsilon_i \quad (2\text{-}1)$$

Where $\Delta Allow_i$ is the % change in the housing allowance in location i from 1996-2001. $Inflation_i$ is the % change in the cost of housing from 1996-2001.[30] $Adj1_i$ and $Adj2_i$ are the system adjustment variables that measure housing allowance inequity under the old BAQ system. Because negative changes in allowances were not permitted after 1999, a spline regression was implemented, where Adj* is the level at which the BAH system was not allowed to fully adjust in the negative direction. Thus, Adj1 and Adj2 are defined as

$$Adj1 = Adj \text{ for } Adj \leq Adj^* \quad (2\text{-}2)$$

$$= Adj^* \text{ otherwise.}$$

$$Adj2 = Adj - Adj^* \text{ for } Adj > Adj^* \quad (2\text{-}3)$$

$$= 0 \text{ otherwise.}$$

This theory implies that below Adj*, the adjustment variable has no effect, because allowances were not allowed to adjust in the downward direction. The coefficient on the Adj2 variable is expected to be positive, indicating that above Adj*, allowances adjusted upward, as the FMR rose in comparison to the housing allowance in 1996. The X_i is a vector of explanatory variables including ln(% Democratic vote), ln(population), ln(number of military personnel assigned to a location), and branch-of-service dummy variables. The fixed effects μ_s captures unobserved variation at the state.

The model has been computed for each individual rank because each rank has a different housing standard. Therefore, the Adj* break point is specific to each rank and

[29] Presidential election results from (Leip, 2001) and (Hall and Gaquin, 1997)

requires the model to be computed individually by rank. The spline break points ranged from -0.90 for the rank of O-5 to -0.06 for the rank of E-4.[31]

Table 2-1 shows results for this analysis. For brevity, only results for the rank of E-4 are shown. Results in Specification 1 show a positive and significant coefficient (0.811) for the Inflation variable. The coefficient is within a 95% confidence interval of 1, indicating that housing allowances increased in proportion to increases in rental cost inflation. An insignificant coefficient is shown for the Adj1 variable, indicating that allowances were not fully adjusted in locations where Adj $\leq$ Adj* (-0.061), or where housing allowances were at least 6% greater than the FMR. The positive significant coefficient (0.628) for the Adj2 variable indicates that allowances where Adj>Adj* were adjusted for cost inequity. However, the elasticity for this variable is less than 1.

Specification 1 was also computed for each individual rank. Results for the ranks of E-4 through E-6 were all shown to have an Inflation elasticity within a 95% confidence interval of 1 while ranks E-7 through O-7 had inflation elasticities statistically less than 1, with the magnitude of the coefficient dropping with increases in rank. This result is not surprising, given the DoD's goal of eliminating the "death-spiral" of allowances for lower ranks. Results for the Adj1 variable by rank were insignificant at a 0.05 level for all specifications. Coefficients for the Adj2 variable ranged from 0.525 to 0.869, with the coefficient being larger for enlisted ranks.

Specification 2 adds a state fixed effect. The state fixed effect is used to control for all variation at the state to test local-level effects. The magnitude of the Inflation

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[30] The model was also computed using a subset of data where median housing prices were available. Results for this model did not vary significantly for the fair market rent model.

[31] The range of break points is for Specification 1, Table 2-1. The break points for each rank are relatively reasonable with Adj2=0 for less than 20% of the observations.

variable (1.012) increases, the magnitude of Adj2 variable (0.616) decreases slightly, and the Adj1 variable remains insignificant. Results from Specifications 1 and 2 indicate that the BAH policy adjusted housing allowances with local rental cost increases and adjusted allowances for pre-BAH allowance inequities. However, the insignificant result for the Adj1 variable shows that the inequity adjustments were not imposed where the housing allowance was high relative to FMR in 1996. Next, Specifications 3-8 use the model to test how allowance changes were affected according to the remaining explanatory variables.

Specifications 3 and 4 add the ln(% Democratic) vote as an explanatory variable to test if the policy was politically influenced. Signs on the coefficients for the cost and adjustment variables remain consistent with previous results with minor decreases in the magnitudes. A significantly positive coefficient is shown for the % Democrat vote in both specifications (0.187 and 0.142). Results for Specification 3 indicate housing allowance increases rose 0.187% with a 1% increase in the % Democratic vote. That is, a 1 standard deviation increase in the % Democratic vote from the mean resulted in a 3.42% greater housing allowance increase.[32]

Specifications 5 and 6 add the ln(population), ln(number of military personnel assigned to a location), and branch of service dummy variables. The Inflation, Adj2, and % Democratic vote variables remained statistically significant and all the coefficients decrease in magnitude compared to the previous specifications. Additionally, a significantly positive coefficient (0.031 and 0.029) is shown for the population variable. The magnitude of this effect is relatively small with allowance increases rising 0.145%

[32] The mean % Democratic vote at the local level was 46.29 with a standard deviation of 8.48. This corresponds to an 18.32% increase in the % Democratic vote. Examples of

with a 1 standard deviation increase in the population. Significant coefficients are also shown for the Army (-0.036) and Air Force (-0.044) dummy variables in Specification 5 and the Marine Corps (-0.092) and Coast Guard (0.067) dummy variables in Specification 6. These results compare allowance changes to Navy locations. The magnitudes of the effects are quite small, all measuring less than 0.1%.

Finally, Specifications 7 and 8 add an interaction variable between the % Democratic vote and population. This interaction term is added to see if the Democratic effect was greater for the larger Democratic districts. The positive significant coefficient for the interaction term (0.072 and 0.082) in both specifications indicates that the magnitude of the Democratic effect rose with increases in population. Specification 7 estimates that a 1% increase in the % Democratic vote resulted in a (0.212 + .072 * ln(population)) % rise in housing allowance increases. The model estimates that a 1 standard deviation increase in the % Democratic vote at the mean population and at 1 standard deviation above the mean resulted in a 4.39% and 5.02% respective increase in housing allowances, post-implementation.[33]

The results shown in Table 2-1 indicate that the BAH policy increased allowances in relative proportion to changes in rental costs and adjusted allowances for pre-BAH inequity. The insignificant results for the Adj1 variables indicate allowances were not allowed to adjust downward when necessary. Additionally, results also show statistically significant policy effects for the % Democratic vote, population, and branch of service dummy variables. The Democratic effect was also shown to increase significantly with

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locations, which exhibit this variation, are Sacramento, CA and New Orleans, LA with respective % Democratic voting of 46.2% and 55.0%.

[33] The mean population is 0.68 with a 1.7 standard deviation. Examples of locations with the mean population and 1 standard deviation above the mean are Knoxville, TN and Pittsburgh, PA with respective populations in 2000 of 687,000 and 2,359,000.

the population. Next, I further analyze of these policy effects by examining housing allowances on a yearly basis.

Yearly Allowance Analysis

I analyze allowances on a yearly basis from 1996-2001 to get a detailed view of the BAH policy effects. This analysis uses a highly parameterized linear fixed effects regression model with the following format:

$$Allow_{ity} = \beta X_{iy,} + \gamma(Policy_y) + \delta(int_{iy}) + \alpha_{it} + \varepsilon_{ity} \quad (2\text{-}4)$$

Where $Allow_{ity}$ is the natural log of the housing allowance in location i for rank t in year y. X_{iy} is a vector of explanatory variables including: ln(% Democratic vote), ln(fair market rent), ln(population), ln(number of military personnel assigned to a location), and branch of service dummy variables. $Policy_y$ is a series of dummy variables indicating whether the housing allowance was computed before full BAH implementation (1996-1999) or after full BAH policy implementation (2000-2001). The int_{iy} are interaction variables between explanatory variables in the X_{iy} vector and the $Policy_y$ dummy variables. Additionally, the model uses fixed effects and computes robust standard errors. The fixed effect, α_i, captures unobserved variation across locations and ranks and standard errors clustered by location.

To analyze the overall effects from the BAH policy, the model is first computed without the int_{iy} interaction variables. Table 2-2 shows results for this analysis. The policy variables have been entered in two different ways. Specification 1 includes separate policy variables for the years during partial BAH implementation (1998-1999) and years post-implementation (2000-2001). The coefficients for the policy variables compare housing allowances to years during pre-implementation (1996-1997). Results for this specification show significantly positive coefficients for the FMR (0.782),

population (0.488) and post-policy (0.052) variables. An insignificant coefficient is shown for the during-policy variable. The result for the FMR variable indicates the cost elasticity of housing allowances was slightly less than 1. The result for the population variable indicates that housing allowances increased with increases in the population after controlling for housing rental costs. Finally, results for the policy variables indicate that compared to pre-implementation (1996-1997), changes in housing allowances during BAH implementation (1998-1999) were insignificant and changes in allowances were positive and significant after full BAH implementation (2000-2001), after controlling for FMR and population. The insignificant result for the during-policy variable is not surprising. In these years, some allowances were adjusted upward while others were adjusted downward, with an overall insignificant effect. The positive and significant coefficient for the post-policy variable is evident because allowances were not adjusted downward after 1999 and additional funds were added to the housing allowance program.

Next, Specification 2 restricts the model by dropping the during-policy variable. Interpretation of the post-policy variable in these specifications compares the changes in housing allowances from 2000-2001 to 1996-1999. Results for the restricted model are similar to the unrestricted model, with significantly positive coefficients for the FMR, population, and post-policy variables. Additionally, the identical R-squared values (0.9491) for the two models indicate there are no significant differences between the restricted and unrestricted model. Therefore, further analysis of the BAH policy effects will use the second methodology comparing the post-policy housing allowances to allowances in years 1996-1999.[34]

[34] Analysis was also conducted using both the during-policy and post-policy variables with similar results for the post-policy effects.

Next, I add interaction variables to the model to determine the differential policy effects for the variables of interest. Two-way interaction terms are first added between the policy variable and the explanatory variables. Results from these two-way interaction variables indicate to what extent the BAH policy change differentially affected allowances according to these location and rank characteristics. Table 2-3 shows results for this analysis.

Results for Specification 1 show a significantly positive coefficient for the % Democratic vote * post-policy interaction variable (0.114), indicating that allowance increases were 0.114% greater for every 1% increase in the % Democratic vote, post-implementation. The model estimates a 1 standard deviation increase from the mean in the % Democratic vote resulted in a 2.10% rise in housing allowances, post-implementation. Additionally, a positive and significant coefficient (0.141) is shown for the fair market rent * post-policy interaction variable. This result indicates that post-implementation, for every 1% increase in fair market rent, housing allowance increases were 0.14% greater in magnitude. That is, post-implementation, the cost elasticity of housing was closer to the ideal value of 1. Hence, the BAH system better reflects rental costs than the previous BAQ system. The significantly negative coefficient (-0.036) for the officer ranks * post-policy variable indicates allowance increases for the officer ranks rose 0.036% less than those for enlisted ranks following full BAH implementation. This result reflects the DoD's effort to correct the death-spiral of allowances for lower-ranks. Finally, negative and significant coefficients are shown for the Army (-0.027) and Marine Corps (-0.043) dummy variables. The magnitudes of these effects are relatively small with allowances, on average, 0.027% and 0.043% less at Army and Marine Corps locations versus Navy locations, post-implementation.

Specification 2 adds a two-way interaction variable between the % Democratic vote and the population, and a three-way interaction variable between the % Democratic vote, population, and the post-policy variable. These interaction variables are added to the model to determine if the Democratic effect varied with the population. The positive and significant coefficient for the three-way interaction variable (0.044) indicates the post-policy Democratic effect increases with the population. The Democratic effect must be interpreted in its entirety, with the post-policy effect equal to (0.162 + 0.044 * ln(population)). The model estimates that a 1 standard deviation increase from the mean in the % Democratic vote with population at the mean and at 1 standard deviation above the mean resulted in a 3.29% and 3.68% respective increase in housing allowances, post-implementation. This result indicates that the Democratic effect was greater in the large metropolitan areas where Democratic voting tends to be concentrated.

Next, Specification 3 interacts the % Democratic vote, fair market rent, and the policy variable. This interaction variable is included to determine if the Democratic effect differed with the cost of housing. The positive significant coefficient (0.369) for the % Democrat*fair market rent*post-policy variable indicates that the Democratic effect increase 0.37% with a 1% increase in the fair market rent. The model estimates that a 1 standard deviation increase from the mean in the % Democratic vote with fair market rent at the mean and 1 standard deviation above the mean resulted in a 2.09% and 3.64% respective increase in allowances, post-implementation.[35]

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[35] The mean fair market rent from 1996-2001 was $565.75 with a standard deviation of $146.01. Examples of locations with approximately the mean fair market rent and 1 standard deviation above the mean are Kansas City, MO and Denver, CO with respective fair market rents in 2000 of $574 and $728.

Finally, Specifications 4 through 6 add state[36] * post-policy interaction variables. These highly parameterized regressions eliminate all post-policy variation at the state level, leaving only the policy effects attributed at the local level. The signs and significance of all variables remain consistent with previous results with the exception of the Army * post-policy variable. Additionally, the magnitude of the Democratic effect decreases in all specifications. Specification 4 estimates a 1 standard deviation from the mean increase in the % Democratic vote resulted in a 0.99% increase in allowances, post-implementation. Specification 5 estimates that the same increase in the Democratic vote with population at the mean and 1 standard deviation above the mean resulted in a 2.03% and 2.46% respective increase in housing allowances, post-implementation. Finally, Specification 6 estimates that a 1 standard deviation from the mean increase in % Democratic vote with fair market rent at the mean and 1 standard deviation above the mean resulted in a 1.30% and 2.56% respective increase in housing allowances, post-implementation.

Results from Table 2-3 show significant policy effects for the % Democratic vote at the local level. Additionally, the effect increases significantly with the population and fair market rent.[37]

To test the robustness of the Democratic effect, further analysis is conducted. Using Specification 2 from Table 2-3, the model is re-computed replacing the local Democratic vote with state Democratic vote to measure the magnitude of the effect at the state-level. This is accomplished to test whether the effect is stronger at the state or local level. Additionally, using pre-truncation data from 2000, the model is re-computed to see

[36] Includes the 50 states and the District of Columbia.

if the Democratic effect would have been evident if allowances would have been allowed to adjust downward after 1999.[38] The purpose of this simulation is to test if the truncation of allowances caused the Democratic effect by not allowing the downward adjustment of allowances where needed.

Table 2-4 presents results for these analyses. Column 1 presents results using local election results and Column 2 presents results using state election results. For brevity, results for the coefficients on all other variables are not shown. Row 1 shows results for the actual allowances paid to service members while Row 2 shows results for the non-truncation simulation. For Row 1, the coefficient (0.135) for the % Democratic * post policy variable based on the state election is slightly larger than the coefficient (0.114) based on the local elections. However, the model estimates that a 1 standard deviation increase from the mean in the state's % Democratic vote resulted in a 1.78% increase in housing allowances, post-implementation.[39] This compares to the 2.09% increase in allowances with a 1 standard deviation increase from the mean in the local election result. The model fit is better for the local election specification than state election specification respective R-Squared values of 0.9576 and 0.9573. Next, Row 2

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[37] The model was also computed by segmenting the data by population and fair market rent. Results showed increases in the magnitude of the % Democratic vote * post-policy variable for the higher population and fair market rent locations.

[38] The data obtained by the author was a "draft" of the actual 2000-pre-truncation allowances. These allowances may have been adjusted by up to 1% or 2% before final release. Additionally, the 2001-pre-truncation allowances were not available; therefore, estimates for the negative adjustment of allowances in 2001 were computed by multiplying the 2000 pre-truncation allowance by the average increase for non-truncated allowances from 2001-2002. See Appendix B for an illustration.

[39] The mean % Democratic vote at the state level was 48.00 with a standard deviation of 6.34. This corresponds to a 13.21% increase in the % Democratic vote. Examples of states with the mean % Democratic vote and 1 standard deviation above the mean are Tennessee and Illinois with respective % Democratic voting of 48.0% and 54.3%.

2 presents results for the non-truncation simulation.[40] These results indicate what the post-policy effects would have approximately been if Congress had not truncated allowances. Results show a positive significant coefficient for both the local (0.144) and state (0.172) specifications. That is, a 1 standard deviation from the mean increase in the % Democratic vote at the local and state level would have resulted in a 2.64% and a 2.27% respective increase in housing allowances, post-implementation. This result compares to a 2.09% and 1.78% respective increase when using the actual truncated data.

Results for these specifications indicate that the post-policy Democratic effect is significant with either the local or state election results. However, the better fit to the data indicates the election effects are better measured at the local-level. Additionally, the results from the non-truncation simulation indicate that the truncation action was not the driving force behind the Democratic effect and, in fact, likely diminished the magnitude of the effect.

Post-Policy Analysis

The final analysis for this paper examines the changes in housing allowances from 2001-2002 to see if the policy effects are evident post-implementation. An analysis identical to that in Table 2-1 is conducted, regressing the change in allowance as a function of the change in Inflation, Adj1, Adj2, and the other explanatory variables.[41]

Table 2-5 presents results for this analysis. Results show that the housing allowance changes from 2001-2002 increased positively with changes in the Inflation variable and the Adj2 variable in all but Specification 6. The magnitudes of the Inflation

[40] In addition to the analysis presented, the model was also computed excluding the 2001 estimated allowances and estimating the post-policy effects only using the 2000-non-truncated data. Positive and significant results for the post-policy Democratic effect were found in these specifications.

variable ranges from 0.093 to 0.320, indicating that the cost elasticity is significantly less than 1. The magnitude of the Adj2 variable is significant, but very small, ranging from 0.080 to 0.135. The significance of this variable is somewhat surprising, indicating that all cost inequity adjustments were not fully corrected during policy implementation. The Adj1, % Democratic vote, number of military personnel, and branch of service variables are insignificant in all specifications, indicating that the previous effects have disappeared. The population variable (0.005) is positive and significant in Specification 5, but the magnitude of the effect is exceptionally low. Additionally, the state fixed effect in Specification 6 causes the population variable to be insignificant.

Overall, the post-policy analysis shows that allowance changes from 2001-2002 had no significant policy effects.

Conclusions

Results from this study provide considerable evidence that the BAH policy change had a significant impact on military housing allowances. Overall, housing allowances increased for most locations and ranks, but significant differential policy effects were evident. Some of these effects were expected with the DoD's goal of achieving geographic equity of allowances and eliminating the "death spiral" for lower ranks.

The positive fair market rent effect shows that allowances under the BAH system better reflects rental costs than the previous BAQ system and the negative officer effect corroborates a rank-equity adjustment. Results for the adjustment variables indicate that pre-BAH inequity adjustments were made, but these adjustments were limited by Congresses truncation of allowances in 2000. However, the positive Democratic effect

[41] Analysis using the methodology in Table 2-5 was also conducted with insignificant

cannot be reasonably attributed to the DoD's goals. Estimates for allowance increases associated with a 1 standard deviation increase from the mean in the % Democratic vote ranged from 0.99% to 3.42%. The Democratic effect was also shown to increase significantly with the population and fair market rent. Estimates for the same increase in the Democratic with population at 1 standard deviation above the mean ranged from 2.46% to 5.02%. Estimates for a 1 standard deviation increase from the mean in the % Democratic vote with fair market rent at 1 standard deviation above the mean ranged from 1.30% to 3.64%. Additionally, the non-truncation simulation showed that the magnitude of the Democratic effect was likely diminished by Congresses decision to truncate allowances. Finally, the Democratic effect appears to have disappeared in the most recent year, with no statistically significant effects shown in allowance changes from 2001-2002.

These results indicate that the DoD's goal of creating geographic equity has not fully been met. Allowances are relatively higher in areas with larger populations and a greater number of Democratic voters, after controlling for rental costs. Despite these relative differences, allowances under the BAH system better reflect rental costs than they previously did under the BAQ system. The Democratic and population effects are relatively small when compared to the positive post-policy effects (i.e., rental cost and inequity adjustments) associated with the policy change. Additionally, the methodology used to compute allowances appears to be sound and as the data collection process is further refined, this goal may yet be achieved.

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results for the election effects.

Table 2-1. Total change in allowances, regression results, 1996-2001, rank E-4

Specification	1	2	3	4	5	6	7	8
Inflation	0.811***	1.012***	0.773***	0.944***	0.610***	0.742***	0.620***	0.732***
	(0.103)	(0.107)	(0.099)	(0.107)	(0.099)	(0.108)	(0.098)	(0.106)
Adj1	-0.360	-0.493	-0.354	-0.433	-0.303	-0.362	-0.207	-0.331
	(0.346)	(0.352)	(0.330)	(0.340)	(0.259)	(0.255)	(0.253)	(0.257)
Adj2	0.628***	0.616***	0.544***	0.594***	0.489***	0.582***	0.473***	0.568***
	(0.072)	(0.077)	(0.075)	(0.077)	(0.073)	(0.079)	(0.073)	(0.077)
% Democratic vote			0.187***	0.142***	0.116***	0.084*	0.212***	0.195***
			(0.037)	(0.045)	(0.038)	(0.045)	(0.050)	(0.056)
Population (millions)					0.031***	0.029***	-0.243***	-0.283***
					(0.006)	(0.007)	(0.094)	(0.097)
Military personnel assigned (thousands)					0.002	-0.001	-0.001	-0.003
					(0.005)	(0.006)	(0.005)	(0.006)
Army					-0.036*	-0.034	-0.039*	-0.037*
					(0.022)	(0.022)	(0.022)	(0.022)
Air Force					-0.044*	-0.028	-0.047**	-0.030
					(0.023)	(0.023)	(0.023)	(0.023)
Marine Corps					-0.058	-0.092**	-0.059	-0.095**
					(0.042)	(0.041)	(0.042)	(0.040)
Coast Guard					0.044	0.067**	0.027	0.052*
					(0.030)	(0.031)	(0.031)	(0.030)
% Democrat * Population							0.072***	0.082***
							(0.025)	(0.025)
Adj*	0.061	0.064	0.060	0.062	0.038	0.034	0.036	0.037
R-Sqr	0.312	0.446	0.362	0.464	0.427	0.522	0.441	0.540
Observations	309	309	309	309	309	309	309	309
State fixed effect	no	yes	no	yes	no	yes	no	yes

Note - Dependent variable is the % change in the allowance for each location from 1996-2001. Standard errors are in parentheses.

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Democratic effect[1]	NA	NA	3.422***	2.603***	2.121***	1.544*	4.390***	4.142***
			(0.685)	(0.833)	(0.700)	(0.819)	(1.042)	(1.138)
Democratic effect[2]	NA	NA	NA	NA	NA	NA	5.021***	4.862***
							(1.213)	(1.306)

[1]The Democratic effect is evaluated for a 1 standard deviation from the mean increase in the % Democratic vote. Specifications with an interaction variable with the population is evaluated with population at the mean

[2]Democratic effect is evaluated with population at one standard deviation above the mean

Table 2-2. Change in housing allowance policy effects

Specification	1	2
Fair Market Rent	0.782***	0.779***
	(0.106)	(0.091)
Population (millions)	0.488***	0.482***
	(0.146)	(0.143)
During-Policy	-0.0007	NA
	(0.007)	
Post-Policy	0.052***	0.053***
	(0.010)	(0.005)
R-Sqr	0.9491	0.9491
Observations	26,546	26,546

Note - Dependent variable is the natural log of the housing allowance. Robust standard errors are in parentheses and are clustered by location. All specifications include a location by rank fixed effect.

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 2-3. Post-policy differential effects

Specification	1	2	3	4	5	6
Fair market rent	0.584***	0.588***	0.831	0.561***	0.563***	0.570
	(0.062)	(0.059)	(0.913)	(0.072)	(0.067)	(1.048)
Population	0.600***	-1.339	0.643***	0.748***	-2.353	0.798***
	(0.130)	(1.490)	(0.129)	(0.147)	(1.583)	(0.150)
% Democrat * Post-policy	0.114***	0.162***	-2.226***	0.054**	0.092**	-1.825***
	(0.020)	(0.035)	(0.532)	(0.024)	(0.041)	(0.532)
FMR * Post-policy	0.141***	0.124***	-1.281***	0.193***	0.177***	-0.975***
	(0.025)	(0.026)	(0.321)	(0.041)	(0.042)	(0.489)
Population * Post-policy	0.008	-0.161**	0.005	0.005	-0.181**	0.004
	(0.004)	(0.066)	(0.004)	(0.005)	(0.068)	(0.005)
Military Pers * Post-policy	-0.002	-0.003	-0.002	-0.003	-0.004	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Officer * Post-policy	-0.036***	-0.036***	-0.036***	-0.036***	-0.036***	-0.036***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Army * Post-policy	-0.027*	-0.031*	-0.029*	-0.022	-0.026	-0.024
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
USAF * Post-policy	-0.020	-0.024	-0.024	-0.010	-0.014	-0.016
	(0.016)	(0.016)	(0.016)	(0.015)	(0.016)	(0.016)
USMC * Post-policy	-0.043*	-0.046*	-0.041*	-0.048**	-0.053**	-0.047*
	(0.026)	(0.025)	(0.023)	(0.023)	(0.022)	(0.023)
USCG * Post-policy	0.009	-0.0004	0.008	0.026	0.017	0.019
	(0.022)	(0.023)	(0.022)	(0.021)	(0.022)	(0.021)
% Democrat * Population		0.519			0.830**	
		(0.396)			(0.422)	
% Democrat * Population * Post-policy		0.044**			0.049***	
		(0.018)			(0.018)	
% Democrat* FMR			-0.071			-0.008
			(0.238)			(0.278)
% Democrat* FMR*Post-policy			0.369***			0.299**
			(0.085)			(0.125)
R-Sqr	0.958	0.958	0.958	0.962	0.963	0.962
Observations	26182	26182	26182	26182	26182	26182
State*Policy interaction	no	no	no	yes	yes	yes

Note - Dependent variable is the natural log of the housing allowance. Robust standard errors are ain parentheses and are clustered by location. All specifications include a location by rank fixed effect.
* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Democratic effect[1]	2.095***	3.287***	2.089***	0.993**	2.032**	1.296***
	(0.366)	(0.741)	(0.382)	(0.441)	(0.861)	(0.591)
Democratic effect[2]	NA	3.678***	3.644***	NA	2.460**	2.556***
		(0.876)	(0.565)		(0.997)	(1.001)

[1]The Democratic effect is evaluated for a 1 standard deviation from the mean increase in the % Democratic vote. Specifications with an interaction variable with the population and FMR are evaluated with these respective variables at the mean.

[2]Population and FMR are evaluated at one standard deviation above the mean

Table 2-4. Post-policy Democratic effect

		Truncated Allowances		Non-Truncated Simulation	
	Election	Local	State	Local	State
Data segmentation	Variable	% Democrat * Post-Policy	% Democrat * Post-Policy	% Democrat * Post-Policy	% Democrat * Post-Policy
All data		0.114***	0.135***	0.144***	0.172***
		(0.020)	(0.031)	(0.025)	(0.038)
	R-Sqr	0.9576	0.9573	0.9370	0.9367
	Observations	26,182	26,182	26,182	26,182
Top 1/3 fair market rent areas		0.158***	0.211***	0.194***	0.246***
		(0.048)	(0.053)	(0.055)	(0.059)
	R-Sqr	0.9400	0.9408	0.9255	0.9264
	Observations	9,243	9,243	9,243	9,243
Top 1/3 population areas		0.108**	0.225***	0.108**	0.239***
		(0.041)	(0.055)	(0.050)	(0.067)
	R-Sqr	0.9532	0.9543	0.9408	0.9420
	Observations	9,672	9,672	9,672	9,672

Note - Dependent variable is the natural log of the housing allowance. Robust standard errors are in parentheses and are clustered by location. All specifications include a location by rank fixed effect.

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 2-5. Post-policy change in allowances, 2001-2002, rank E-4

Specification	1	2	3	4	5	6
Inflation	0.320***	0.154**	0.301***	0.160**	0.233***	0.093
	(0.071)	(0.078)	(0.073)	(0.079)	(0.080)	(0.089)
Adj1	-0.082	-0.015	-0.080	-0.014	-0.133	-0.030
	(0.107)	(0.120)	(0.109	(0.120)	(0.109)	(0.122)
Adj2	0.123***	0.082***	0.125***	0.080***	0.135***	0.088***
	(0.025)	(0.029)	(0.025)	(0.029)	(0.026)	(0.031)
% Democratic vote			0.017	0.008	0.011	-0.012
			(0.016)	(0.020)	(0.017)	(0.021)
Population (millions)					0.005*	0.003
					(0.003)	(0.003)
Military personnel assigned (thousands)					0.0003	0.001
					(0.002)	(0.003)
Army					-0.009	0.002
					(0.010)	(0.011)
Air Force					-0.009	-0.004
					(0.010)	(0.011)
Marine Corps					-0.004	-0.005
					(0.020)	(0.021)
Coast Guard					-0.021	0.010
					(0.033)	(0.015)
Adj*	0.258	0.267	0.258	0.267	0.258	0.267
R-Sqr	0.0902	0.1499	0.0907	0.1476	0.0962	0.1511
Observations	365	365	365	365	363	363
State fixed effect	no	yes	no	yes	no	yes

Note - Dependent variable is the % change in the allowance for each location from 2000-2002. Standard errors are in parentheses.

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

CHAPTER 3
LOCAL LABOR MARKET EFFECTS ON AIR FORCE REENLISTMENTS

Military enlisted retention is an issue at the forefront of the national defense debate. With lateral entry[42] almost non-existent in the US Armed Services, retention is the only way to ensure qualified personnel are available to fill future leadership positions. As Lt. Gen. Donald L. Peterson, Deputy Chief of Staff for Air Force Personnel, stated, "It takes 8 years to replace the experience of an 8 year Non Commissioned Officer (NCO)."[43] Although retention is a significant issue for all the branches of service, in recent years the Air Force has had the most trouble retaining its personnel (Asch and Warner, 2001). Retention goals for first-term reenlistments have been missed 4 out of the last 5 years, while second-term retention levels haven't been met since Fiscal Year 1996 (FY96).[44]

Many initiatives have been implemented in attempt to resolve the retention problem. In FY00, Congress passed legislation to increase pay raises for military personnel.[45] The legislation also made modest structural changes to the pay table, enhanced special pays and bonuses, and reduced inequity in the retirement system.

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[42] The US Military is a hierarchical organization, which trains its personnel within the organization. With a few exceptions in the medical and legal fields, personnel are not allowed to enter laterally into higher-ranking positions.
[43] Parr (2001).
[44] The Air Force's goal is to retain 55% of its first-term airmen and 75% of its second-term airmen. FY01 marked the first year since FY97 that first-term goals were met. Second-term reenlistments have been below 75% since FY96.
[45] Before FY00, pay raises were set at the rate of increase of the Employment Cost Index (ECI) minus 0.5%. The FY00 pay legislation increases pay raises to the ECI increase plus 0.5% for years 2000 to 2006.

However, the legislation did not address the overall structural problem with the military pay table (Asch and Warner, 2001).

Economists have long pointed out that the military pay table does not adequately distinguish between occupational subgroups within the services (Rosen, 1992; Asch and Warner, 2001; Asch 1993). This incomplete pay distinction results in specific occupational shortfalls and surpluses, resulting in inefficiencies in the military labor market (Rosen, 1992). To combat this problem, occupational specific bonuses and special payments have been implemented throughout the services. Reenlistment bonuses in the Air Force were re-implemented in FY97 for 62 career fields, with $25 million paid in bonuses. The reenlistment bonus program has grown each year with over $122 million paid in bonuses in FY00.[46] Reenlistment bonuses have helped retention efforts, but occupation specific shortages still exist. Despite large bonuses, retention levels in many fields are well below goals for both first-term and second-term airmen.[47]

One could argue that military wages are also out of line with local labor market wages. With the exception of housing allowances,[48] military wages do not vary across locations within the United States.[49] However, the theory of compensating wage

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[46] Bonuses represent a relatively small share of total enlisted wages. For FY00, bonuses represented approximately 11% of total enlisted wages. In FY00 76% of the Air Force's career fields were eligible for a reenlistment bonus.

[47] For example: first-term retention levels in FY00 were 49% for computer programmers was, 26% for fire fighters, 35% for crypto-linguists and 44% for airborne communications.

[48] Basic Allowance for Housing is an allowance given to all military personnel not residing in a government-owned housing facility. The amount of the allowance varies by the member's rank, location of assignment, and dependency status (i.e., married or single).

[49] Modest Cost of Living Allowances (COLAs) are provided in high cost areas of the country. These COLAs do not affect a high percentage of military personnel in the Air Force with only 2 of 67 bases receiving a COLA (Los Angeles AFB, CA and Hanscomb

differentials predicts that wages adjust according to the cost of living and amenities of a location (Rosen, 1979; Haurin, 1980; Roback, 1982; Blomquist, 1988; and Graves, 1999). Other evidence suggests that wages are adjusted to fully compensate workers for the cost of living in a location (Aggarwal and Kenny 1996, and Kenny and Denslow 1980). This leads one to ask whether military retention problems are further compounded by the disequilibria of military wages within the local labor market where personnel are assigned. That is, are personnel more likely to exit the military when local civilian wages are relatively higher than the military wages (or more likely to reenlist when civilian wages are relatively lower) at the location of assignment?

All the previous retention studies have examined the military labor market from a national perspective and have not taken into account the local labor market's effect on retention. In these models all variation in reenlistment is attributed to the national wage and unemployment effects. The national labor model has likely been used because of data limitations[50] and the traditional thinking that military personnel move every two years. However, current statistics show that personnel often spend a significant length of time at a single location. Table 3-1 shows April 2002 time-on-station (TOS) statistics for permanent party enlisted personnel assigned in the continental United States (CONUS). As of April 2002, 52% of Air Force permanent party enlisted personnel, stationed in the CONUS, had more than 2 years TOS. Additionally, 34% of personnel had more than 3 years TOS, 21% had more than 4 years TOS, and 15% had more than 5 years TOS. Because personnel tend to spend 3 or more years at a CONUS assignment, it is

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AFB, MA). For example in 2001, junior enlisted personnel received $19 per month in COLA in Los Angeles.

conceivable that the local labor market plays a role in the reenlistment decision. In fact, it is not uncommon for first-term airmen assigned in the CONUS to spend their entire enlistment at a single location.[51]

To determine if local labor markets play a significant role in the reenlistment decision, I analyze military wages and reenlistments at the local level (i.e., location of assignment for reenlisting personnel). First-term[52] reenlistments for the Air Force from FY96 through FY01 are analyzed by occupation and location. Results show that military wages, when compared to civilian wages, are not fully adjusted for the cost of living and amenity differences across locations and this lack of adjustment significantly impacts retention. Evidence suggests that retention could be better optimized by further adjusting wages for local labor market conditions. Additionally, further analysis suggests that the disequilibria of military and civilian wages may affect the quality of personnel who reenlist at each location.

Military Wage Theory, Compensating Wage Differentials, and Retention

Military Wage Theory

Wage theory and empirical studies show that the enlisted military compensation system is not designed to efficiently recruit and retain qualified personnel. Asch, Hosek, and Warner (2001) examined enlisted wages and compared them to civilian wages over time. They found that military compensation equated to the 70th percentile of national civilian wages for high school graduates. Although this appears to be favorable for

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[50] Local civilian wage estimates across different occupations have been available from the Bureau of Labor and statistics only since 1997.
[51] This is after completion of basic military training and technical training schools.
[52] Second-term and career reenlistments were not analyzed due to lack of demographic data (i.e. rank and time-in-service) for each reenlistment decision. First-term

military retention, high school graduate wages no longer fit the description of the military enlisted force. Education levels for enlisted members have risen dramatically over the past fifteen years. In 1999, 50% of the junior enlisted force had "some-college" compared to only 20% in 1985. Additionally, 20% of E-8's in the military have earned a college degree. Education levels for the Air Force are even higher, with over 93% of E-4's having at least one-year of college and 35% of E-8's having at least a bachelor's degree in 2002.[53] The increased education level of enlisted members requires a higher wage be paid to military members than that of high school graduates. Therefore, Asch and Warner compared military wages to civilian wages for persons with "some college" and found that military wages were at the 50th percentile of this distribution. They argue that the 50th percentile wage is too low because of the military's selectivity (i.e., no criminal records, excellent health, and above average aptitude), rigidity (i.e., subordination of personal freedom and being constantly on call) and risk of injury or death. They also examined the FY00 pay legislation and calculated that the increased pay raises would help the retention problem, but "shortages may persist in critical occupational areas (p.ix)." Additionally, mid-career wage growth will be slower in the military than for that of civilians with some college, even with the pay increases.

Asch (1993 p.1) suggested that "the current compensation method is inappropriate for the modern military" because the system is a product of the pre Word-War II era where military members were typically unskilled "cadre-type" forces. In order to retain personnel, the "expected discounted value of pay over the remaining career of the

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reenlistments provide a relatively homogeneous sample with most personnel at the rank of E-4 with 4-6 years time-in-service.

individual must be at least as great as the next-best alternative (p.20)." Additionally, because "military occupations and branches of service differ in their non-pecuniary characteristics, theoretical analysis suggests compensation should differ across occupations and services."

Compensating Wage Differentials

Economic models predict that civilian wages are compensating in nature. That is, wages will be higher in places with a higher cost of living and with lower amenities. Hoch and Drake (1974), Izraeli (1974), Getz and Huang (1978), Roback, (1982) all showed significant variation in wages with changes in various amenities. Additionally, Graves (1999 p.8) showed that "the returns to both union membership and education are substantially overstated by failing to control for amenity wage compensation (by as much as 50 percent and 20 percent, respectively)."

Other evidence suggests that wages are fully compensated for differences in the cost of living in locations. Aggarwal and Kenny (1996 p.13) and Kenny and Denslow (1980) show evidence of this in finding that "the elasticity of wages with respect to agricultural land prices is equal the elasticity of the cost of living with respect to the agricultural land prices."

Military Retention

Military retention studies were first of interest post-1973 during the early years of the all-volunteer force. All early studies examined retention from a national labor market perspective using civilian wage estimates from post-service civilian wages earnings of

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[53] Statistics obtained from the Headquarters Air Force Personnel, Personnel Statistics Website – Enlisted Demographics, 2002.

veterans.[54] These studies did not account for the reenlisting individual's location of assignment or the differences in missions across locations.

Studies have found that retention is elastic with respect military pay, holding civilian pay constant. Warner and Goldberg (1984)[55], Hosek and Peterson (1985), Saving, et al. (1985)[56], Smith et al. (1991), Daula and Moffit (1995)[57], and Asch and Warner (2001)[58] estimated the first-term military pay elasticity of retention to be 1.0-2.0, 3.5, 4.4, 1.3, and 2.14, respectively. Additionally, studies have also estimated the elasticity with respect to differences in military and civilian pay (ACOL). This measure is less elastic because the magnitude of the pay change is less.[59] Daula and Moffit (1995) and Baldwin and Daula (1985) found estimates of 0.46 and 0.40, respectively.

Unlike previous studies, this study focuses on the local labor market effect on reenlistments. That is, does the variation across locations in the military to civilian wage difference significantly influence the decision to reenlist?

Air Force Reenlistment

Research conducted on the Air Force suggests that reenlistment is highly influenced by the civilian labor market. For Air Force members who decided to reenlist in FY00, the primary reasons to stay were patriotism, job security, and opportunities for education and training. For members who did not reenlist, the primary reasons for

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[54] Most studies have used longitudinal data of post-service earnings from military veterans to estimate the civilian wage opportunities for military enlisted personnel using linear regressions controlling for age, race, military occupation, and post-service work experience.
[55] Warner and Goldberg (1984) examined Navy reenlistments from FY74-78.
[56] Saving, et al. (1985) examined Air Force reenlistments from 1974-1982.
[57] Daula and Moffit examined Army infantry enlistees who entered from 1974-1984 using a dynamic programming model.
[58] Asch and Warner (2001) examined Army reenlistments from 1987-1989.
[59] Daula and Moffit (1995) p. 514.

leaving were availability of comparable civilian jobs (58%) and pay and allowances (58%) (Hamilton and Datko, 2000). Additionally, two-thirds of leaving enlistees reported having civilian jobs lined-up prior to leaving, with 98% reporting the new job had an equal or higher wage than the military. This evidence suggests compensation and availability of civilian employment heavily influence the reenlistment decision for those members who leave.

Table 3-2 shows yearly Air Force retention statistics from 1996-2001.[60] Reenlistments fell dramatically in the late 1990's with the U.S. economic boom, but have risen moderately over the past several years as pay raises increased and the economy softened.

Further examination of reenlistment statistics shows significant variation across locations and occupations. For first-term airmen, reenlistment rates varied significantly from the mean for 42 of 67, bases with the reenlistment rate ranging from 42.8% to 62.6%. In addition to the local wage effects on reenlistment, this variation could in part be attributed to differences in mission, leadership, and other unobserved factors at each location.

Variation in reenlistment rates also exists across occupations. Table 3-3 shows reenlistment statistics by Air Force Specialty Codes (AFSC) at the two-digit level. Although occupational skills can vary within a two-digit AFSC, these statistics show that reenlistment rates vary considerably across occupational categories. Reenlistments are shown to be statistically different from the mean in 25 of 34 occupations. Reenlistment

[60] The data shown include only statistics for members stationed in the CONUS, Alaska, and Hawaii; therefore, these totals differ from overall Air Force reenlistment statistics.

rates ranged from 34.9% for those in precision measurement to 100% for those in the Office of Special Investigation (OSI).

Further analysis of reenlistment statistics by occupation and base show significant variation between bases within a single occupation. For the Aero Maintenance career field, 23 of 58 bases with maintenance personnel had reenlistment rates statistically different from the mean. Reenlistment rates varied from 40.2% to 63.6%. For the Civil Engineering (CE) career field reenlistment rates were statistically significantly significant from the mean at 12 of 63 bases, with rates ranging from 33.1% to 65.3%. Finally, reenlistment rates for the Security Forces career field were statistically significant from the mean at 16 of 65 bases with rates ranging from 21.6% to 60.6%.

Analysis of reenlistment statistics show that reenlistment rates vary significantly by occupation and location and may indicate a local labor market effect on the reenlistment decision. To help answer this question, the reenlistment decision is analyzed at the local level.

Data

Retention statistics by six-digit AFSC and location were collected from Headquarters Air Force Personnel, Retention Status Reports (R-STATUS) for first-term reenlistments from FY96-01. Because employment data[61] were not available, first-term airmen were assumed to be of the rank of E-4 (Senior Airman) with 4 years active military service.[62]

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[61] Employment data such as rank, years of service, age, race and sex were not available for this data set.

[62] Assumption based on typical 4-year enlistment and average promotion times. Current demographic data shows that 91% of Air Force enlisted members with less than six years military service are the rank of Senior Airmen or below.

Military wage estimates were computed for each fiscal year and included basic pay, Basic Allowance for Housing (BAH), Basic Allowance for Subsistence (BAS), reenlistment bonuses, special payments, and the tax advantage from not paying federal income tax on BAH and BAS.[63] Basic pay varies by rank and the number of years of service. BAH varies by rank, location, and dependency status. BAS is a flat rate paid to all enlisted members regardless of rank.[64] Reenlistment bonuses vary by AFSC, length of reenlistment, rank, and time in service.[65] Special payments included in wage calculations were: hazardous duty-pay for flying and foreign language pay.[66] Calculations for the present value of a four-year enlistment assumed annual pay increases of 3.5% in addition to the projected time-in-service and promotion[67] pay increases. A discount value of 10%[68] was assumed for all present value calculations.

Civilian wage estimates were computed using the Bureau of Labor and Statistics (BLS), Occupational Employment Statistics (OES), Occupational Wage Estimates.[69]

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[63] All members were assumed to be in the 15% Federal Income Tax bracket for calculating the tax advantage.

[64] The BAH rate for "with-dependents" and the BAS rate "when authorized to mess separately" were assumed for all wage calculations.

[65] Reenlistment bonuses were calculated using a 4-year reenlistment and the previously assumed years of military service, and rank. These bonuses are paid over a four-year period with one-half of the bonus being paid in the first year and the remaining paid equally over the next three years.

[66] First-term members in flying AFSCs were assumed to have 3 years of flying time. All members in "foreign language" career fields were assumed to receive the foreign language bonus.

[67] Based on promotion statistics, first-term reenlisters were assumed to make Staff Sergeant in the sixth year of service.

[68] A 10% discount rate was chosen because most prior literature assumed this value. However, Warner and Pleeter (2001) calculated military discount values to be as high as 20%; therefore, the model was also tested using a discount value of 20% with no significant changes in results.

[69] The OES provides wage estimates for approximately 700 different occupations. Wage estimates were only available for 1997-2000; therefore, the 1996 estimates were

Mean wage data were collected at the metropolitan and national level.[70] The OES occupational codes were matched to the Air Force Specialty Codes (AFSCs) using job titles and duty description in Air Force Manual 36-2108, *Enlisted Classification*. Air Force Bases were then matched to the closest metropolitan area with OES wage estimates, with 58 of 67 bases located in a metropolitan area. All other bases were found to be within 100 miles of a metropolitan area with wage estimates except Eielson AFB, AK, Columbus AFB, MS, Minot AFB, ND, and Laughlin AFB, TX.[71] For consistency, the models in the analysis have been estimated using the entire data set as well as with the subset of 58 locations where the base is located in the metropolitan area with the wage estimates.

Unlike civilian wage estimates used in previous military retention studies, the OES wages provide an occupation by location estimate. Variation in civilian wages across locations is required to determine if the local labor market has an effect on reenlistment. However, the OES metropolitan area wages are reported to have relative standard errors ranging from 1% to 30%.[72] Due to the relatively high standard error in some estimates, as an alternative specification, the local civilian wage is replaced with

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computed by discounting the 1997 estimates by the Employment Cost Index and 2001 wage estimates were computed by inflating the 2000 estimates. For more information see http://www.bls.gov/oes/

[70] Median wages were also used in the analysis with no significant changes in results compared to mean wages.

[71] The closest metropolitan area to Eielson AFB, AK was Anchorage, AK (357 miles), for Columbus AFB, MS was Jackson, MS (174 miles), Minot AFB, ND was Bismarck, ND (110 miles) and for Laughlin AFB was San Angelo, TX (156 miles). Substitute metropolitan areas were chosen both by proximity and characteristics (i.e., size and amenities).

[72] The range in the relative standard error for the civilian wage estimates are only for the occupations and locations used in this analysis.

the national civilian wage multiplied by a location wage index.[73] This specification has the advantage of eliminating much of the error bias but restricts the compensating variation in wages to that of the average for each location.

To analyze the wage and reenlistment effects from location-specific variables, unemployment, price level, and amenity variables are used in the analysis. Monthly unemployment statistics for each location were collected from the Bureau of Labor and Statistics from 1996-2001. The average percent monthly unemployment for each fiscal year was used for this measure. Price-levels were computed for each location by year using fair market rents[74] from 1996-2001 and the American Chamber of Commerce Researchers Association (ACCRA) data from 1996-1999. The total price level was computed using the weighted price levels (local price/national average price) of housing (22%), utilities (11%), grocery (17%), transportation (13%), health care (7%) and miscellaneous goods and services (30%). Additionally, separate price levels for housing and utilities and all other goods were computed using the same data.[75] ACCRA data were unavailable for 2000 and 2001;therefore, the 1999 data were inflated using the percent increase in the national Consumer Price Index (CPI). Additionally, ACCRA data were unavailable for 3 of 67 locations; therefore, these locations have been omitted from the price level analysis. Finally, to measure an amenity effect on wages, the 1997

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[73] The location wage index was computed by summing the weighted average of the ratio of the local to national wage by occupation for each location.

[74] Fair market rent (FMR) for 2-bedroom apartments are published annually by the US Department of Housing and Urban Development. Additionally, price levels using the Department of Defense housing allowances and ACCRA housing prices were tested in the model with no significant changes in results.

[75] The housing and utility price level was computed as follows: 0.67 + 0.22*housing price index + 0.11*utility price index. The all other goods price index was computed as

January average temperature for each location was obtained from the Bureau of Economic and Business Research, University of Florida.

Appendix A, Table A-2, shows a complete list and summary statistics of the variables used in the analysis.

Methods and Results

The Annualized Cost of Leaving (ACOL) model is the traditional model used to analyze the reenlistment decision.[76] Developed by Warner and Goldberg (1984), the decision to reenlist is a function of observable monetary factors and unobserved taste factors. To measure the observable monetary factors, the Annualized Cost of Leaving (ACOL) is calculated for each individual by subtracting the annualized present value (PV) of the wage of a military enlistment from the annualized PV of the estimated wage of a civilian employment opportunity.[77] Let:

$$ACOL = C_n/\Sigma d^t$$

$$C_n = \Sigma W_m^t d^t - \Sigma W_c^t d^t$$

W_m = Military Wage

W_c = Civilian Wage

$d^t = (1/(1+P))^t$

P = Discount Rate

t = year, 1…4.

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follows: 0.33 + 0.17*grocery price index + 0.07*medical price index + 0.13*transportation price index + 0.30*miscellaneous goods and services price index.

[76] More recent studies have used a dynamic retention model to analyze reenlistments. However, a dynamic model cannot be used to analyze the local labor market effects because personnel do not spend their entire military career in the same location.

Price Level and Amenity Affects on Wages

Before analyzing the reenlistment effects from local labor market conditions, military and civilian wages are analyzed at the local level. As previously cited, civilian wages have been shown to increase with the price level, but decrease with positive amenities (i.e., warmer winters, less rainfall, and less pollution). On the contrary, military wages are only adjusted for housing and utility prices. This suggests that military wages, compared to civilian wages, are not fully adjusted for local labor market conditions.

To test this hypothesis, Table 3-4 shows regressions of log of military wages, log of civilian wages and the log of the ratio of military to civilian wages (ACOL) on the log of the price level and the log of the January average temperature for 1996-2001. The regressions include an occupation by year fixed effect. The fixed effect is used to control for the national variation in wages across occupations and years (i.e., military reenlistment bonuses). Standard errors are clustered by location.

Specifications 1-3 regress the total price level and January average temperature on wages. Results show the cost of living elasticity of military wages to be 0.479 compared to an elasticity of 0.782 for civilian wages. Additionally, the significantly negative coefficient (-0.3142) for the price level in the ACOL specification shows that the military wages are less competitive with civilian wages in places with a higher cost of living. Results for the January average temperature are insignificant in the military wage specification and significantly negative (-0.0410) in the civilian wage specification. The

[77] Warner and Goldberg (1984) found that ACOL is maximized for most first-term members over the horizon of a 4-year reenlistment. Therefore, like Warner and

positive and significant coefficient (0.0398) in the ACOL specification indicates that military wages compared to civilian wages rise 0.04% with a 1% increase in the average January temperature. These results suggest that reenlistments may be negatively affected in locations with higher price levels and lower amenity levels where military wages are less competitive with the civilian labor market.

Finally, Specifications 4 regresses separate price levels (housing/utilities and all other goods) and the January temperature on the ACOL variable. Separate price levels are regressed on ACOL because military wages are only adjusted for housing and utility prices, while civilian wages are adjusted for the price level of all goods. Results confirm this fact as shown by an insignificant coefficient for the housing and utility price level and a significantly negative coefficient (-0.8981) for the all other goods price level. Additionally, the coefficient for the January average temperature (0.0341) is significantly positive.

Results from Table 3-4 show that military wages relative to civilian are not fully adjusted for price level and amenity differences across locations. Military wages are less elastic with respect to the price level and are not adjusted downward for positive amenities. Table 3-5 shows similar results for the analysis using only the subset of 58 locations where the Air Force base is located in the metropolitan area with wage estimates. Further analysis will determine if this disequilibria of military and civilian wages at the local level significantly impacts retention.

Military Labor Market: National vs. Local

To determine if the military reenlistment decision should be analyzed as a purely national labor market (as past studies have done so) or within the context of the local

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Goldberg, this paper only considers wage opportunities over a 4-year horizon.

labor market, the following analysis is conducted. First, if local labor market conditions do not matter, then

$$REENLIST = a + b(ACOL_{natl}) + E, \text{ where:} \quad (1)$$

REENLIST = the probability of reenlistment

$ACOL_{natl} = W_{mil\ natl} - W_{civ\ natl}$

$W_{mil\ natl}$ = National military wage by occupation (AFSC)[78]

$W_{civ\ natl}$ = National civilian wage by occupation

E = Error Term

In this specification, military housing allowances and local civilian wages do not matter. The decision to reenlist is a function of how well off the member is, on average, at the national level. The coefficient for the ACOL variable is expected to be positive. As the average military wage (by occupation) rises compared to the national civilian wage (by occupation), the probability of reenlistment should increase.

Alternatively, if local labor market conditions do matter, then

$$REENLIST = a + b(W_{mil\ local} - W_{civ\ local}) + E, \text{ where:} \quad (2)$$

$ACOL_{local} = W_{mil\ local} - W_{civ\ local}$

$W_{mil\ local}$ = Local military wage by occupation

$W_{civ\ local}$ = Local civilian wage by occupation

In this specification, the decision to reenlist is a function of how well off the member is taking into account local conditions. The coefficient for the local ACOL is expected to

[78] The national military wage by occupation includes basic pay, special payments, reenlistment bonuses, and the with-dependent rate for Basic Allowance for Housing II (BAH II). BAH II is based on the national average for housing and varies by rank and dependency status. BAH II is paid to members returning from overseas assignments and reservists serving on active duty for less than 20 weeks.

be positive and significant. Additionally, if local labor market conditions play an important role, this specification should yield a better fit to the data than equation (1).

Finally, rewriting equation (2) by adding and subtracting the national military and civilian wage:

$$REENLIST = a + b(ACOL_{natl}) + c(W_{mil\ local} - W_{mil\ natl}) - d(W_{civ\ local} - W_{civ\ natl}) + E \quad (3)$$

In this specification, the decision to reenlist is a function of the national ACOL (or occupation fixed effect), local military pay adjustments (housing allowance), and civilian wage adjustments (compensating wage differential). If local labor markets matter, then the coefficient for the local military pay adjustment variable should be positive and the coefficient for the local civilian pay adjustment variable should be negative, after controlling for the national wage difference. That is, the probability of reenlistment should rise as the local military wage rises and the local civilian wage decreases in comparison to the respective national wage. Additionally, equation (3) should yield a better fit than equation (1). Finally, the coefficients for the three parameters in equation (3) should all be equal because the wage elasticity of reenlistment should be equal regardless of where the change in compensation is coming from (national wage difference, military housing allowance, or civilian wage differential).

Table 3-6 and 3-7 show results for the estimates of equations (1) – (3) using a probit model. All coefficients presented are the marginal effects coefficients. Standard errors have been clustered by base by occupation. Standard errors are clustered at this level because the local labor market effect on reenlistment should be correlated within locations and occupations, but independent across locations and occupations.

Specifications 2 and 3 use the actual local civilian wage, while Specifications 5 and 6 uses the indexed local civilian wage estimate (national wage * location wage index).[79]

Results from Specifications 1 and 4[80] (equation 1), Table 3-6, show significantly positive coefficients for the national ACOL (0.0010 and 0.0011) variable. Specification 1 indicates the probability of reenlistment rises 0.0010 with a $1,000 increase in the military to civilian wage difference at the national level. Next, Specifications 2 and 5 (equation 2) show significantly positive coefficients for the local ACOL (0.0013 and 0.0013) variable. These results indicate that the probability of reenlistment rises 0.0013 with a $1,000 increase in the local military to civilian wage difference. Additionally, these local specifications yield a better fit to the data than the respective national specifications with a log-likelihood closer to zero and a higher pseudo R-Square.

Finally, results from Specification 3 and 6 (equation 3) show significant coefficients for the national ACOL (0.0012 and 0.0013), military wage difference (0.0053 and 0.0145), and civilian wage difference (-0.0015 and -0.0055), respectively. These results indicate the decision to reenlist is significantly affected by both the national labor market and the compensating relationship of military and civilian wages at the local level. Specification 3 estimates the probability of reenlistment increases 0.0053 with a $1,000 increases in the local to national military wage difference and decreases 0.0015 with $1,000 increases in the civilian compensating wage differential (civilian wage difference). The coefficients in Specification 3 and 6 exhibits the expected signs, but the

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[79] Note: there 20,899 are missing observations when using the actual local civilian wages. Using the indexed civilian wages allows these observations to be retrieved.

[80] Note: For comparative purposes between the national and local specifications, Specification 1 includes only data points where there was an actual local civilian wage estimate and Specification 4 includes the entire data set.

magnitude of the effects are not equal, with the magnitude of the military wage greater[81] than the other two measures. However, Wald tests between the parameters in Specification 3 indicate the coefficients are not statistically different at the 0.1-level. The higher coefficient may be the result of less error in the military versus civilian wage estimates. [82]

Table 3-7 shows results for the analysis using only the subset of 58 locations where the Air Force Base is located in the metropolitan area with wage estimates. Results do not vary significantly in any of the specifications except for Specification 3 (using the actual OES civilian wage). Results for the military wage difference exhibits the expected sign, but is not statistically significant (0.10-level). However, using a likelihood ratio test to test the restriction that the coefficients in the model are jointly significant results in Chi-Square = 4.24. This result indicates the variables are jointly significant at the 0.0394-level. Therefore, the insignificant result for the military wage difference variable may be due to multicollinearity with the civilian wage difference variable.

Results from Tables 3-6 and 3-7 show the reenlistment decision is likely a function of both the national and local labor markets. To further test the local labor market effect on reenlistment, a highly parameterized linear fixed effects probability model is implemented. The fixed effects model is used to control for unobserved

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[81] Results for Wald tests, testing whether the parameters are different, show the military wage coefficient is significantly greater at the 0.10-level in Specification 6, but not in Specification 3. For Specification 3, respective p-values were 0.116 and 0.131 for the difference between the military wage difference and the other two variables.

[82] Equations (1)-(3) were also computed when including the national and local unemployment levels. In all cases the national unemployment yielded a positive and

variation at the national-level (occupation by year fixed effect) and unobserved variation across missions (command and base-fixed effects), leaving only the variation in reenlistment attributed to the local labor market effect.[83]

Local Wage Effects on Reenlistment

To measure the local labor market wage effect on reenlistment, the reenlistment decision is analyzed using a fixed effects linear probability model with the following format:

$$\Pr(\text{reenlist}_{ijctm}) = \alpha_{jct}(\text{Local ACOL}) + \beta_{ct}(\text{Local Unemployment}) + \phi_{jt} + \gamma_m + \mu_{ct} + \varepsilon_{ijctm},$$

Where the probability to reenlist is a function of the local ACOL (Local ACOL = $W_{mil\ local} - W_{civ\ local}$), local unemployment, and unobserved fixed effects, ϕ_{jt}, γ_m, and μ_{ct} (i.e., occupation by year, command, and base by year dummy variables), for person i, in occupation j, at base c, in command m, in year t. The fixed effects model is used to control for occupational wage variation at the national-level (occupation by year fixed effect) and variation across different missions within the Air Force (command and base by year fixed effects), leaving only the reenlistment variation attributed to the local labor market. The error term is represented by ε_{ijctm}. Standard errors are clustered by base by occupation. Standard errors are clustered at this level because the local labor market

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significant coefficient and the local unemployment was insignificant. Additionally, the signs and significance of the wage variables did not change.

[83] Controlling for the national variation in military wages (occupation by year fixed effect) also controls for the endogeneity of military wages with reenlistment.

effect on reenlistment should be correlated within locations and occupations, but independent across locations and occupations.[84]

A linear probability model was chosen over a non-linear model (i.e., probit or logit) in order to control for unobserved heterogeneity across occupations and years. Probit and logit models produce biased estimators when using unconditional fixed effects (Chamberlain, 1980).[85] To ensure the accuracy of the linear model, the basic model without the fixed effects were run using both a probit and linear probability model. Marginal effects coefficients for the probit model were calculated and the coefficients of the two models were compared. Results show no significant differences between the coefficients for the linear and probit models; therefore, the linear model is used for all subsequent results. Appendix C shows results for the two models. Additionally, for consistency, Appendix D presents results when using a conditional fixed effects Logit model. However, the model's use is limited because standard errors cluster only on the fixed effect groups, the number of within group observations is limited to less than 1,100 and marginal effects coefficients are not computed.

Results for the local ACOL variable are expected to be positive, that is, the probability of reenlistment should increase with increases in the military wage relative to the civilian wage at the local level. Results for the local unemployment variable are also expected to be positive, that is, reenlistments should increase as civilian job opportunities decrease at the location of assignment.

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[84] The models were also run clustering standard errors separately by base and occupation, with no significant changes in the standard errors.

[85] A conditional fixed effect Logit model exists which produces unbiased estimates. However, the model prevents standard error clustering (other than the fixed effect group)

Results for this analysis are shown in Tables 3-8 and 3-9. Specifications 1-4 calculate ACOL using the actual OES civilian wage my metropolitan area, while Specifications 5-6 use the indexed civilian wage in calculating ACOL.[86] All specifications include the occupation by year fixed effect.

Table 3-8, Specification 1, shows a positive and significant coefficient for the local ACOL variable (0.0022) and an insignificant result for the local unemployment variable. This result indicates that the probability of reenlistment increases 0.0022 with a $1,000 increase in the military to civilian wage difference at the local level. The model estimates the local ACOL elasticity to be 0.048 and the corresponding military wage elasticity to be 0.105. Compared to previous retention studies, the magnitude of the wage elasticity is relatively small, however, the elasticity must be viewed in the context of the analysis. The model controls for all variation in wages by occupation at the national level, therefore, this elasticity represents only the wage effect attributed to the geographic variation in wages. Hence, it is not directly comparable to estimates from previous studies.

Next, Specification 2 adds a command[87] fixed effect to control for the retention effects caused by differences in missions across locations. Results remain consistent with the previous specification with a positive and significant coefficient for the ACOL (0.0020) variable and an insignificant coefficient for the local unemployment variable.

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and the model won't compute when the number of within-group observations exceeds 1,100 (STATA).

[86] Note: There are 20,889 missing observations in the sample of 96,554 for the specifications using the actual local civilian wage.

[87] The Air Force Major Command is used as a proxy for the mission at each base.

To further test the model, Specification 3 replaces the command fixed effect with a base by year fixed effect. This highly parameterized model absorbs all unobserved variation at the national and local-level by year, leaving only the intra-occupational variation in wages at each location. The model results in a positive and significant coefficient for the ACOL (0.0009) variable.[88] This result indicates that the reenlistment decision is significantly affected by the wage variation between occupations within a given market at a given time. Although the magnitude of the effect in this model is relatively small, the positive and significant coefficient provides strong evidence of a local labor market effect on reenlistment.[89]

Next, Specification 4 adds an interaction term between the local ACOL variable and the percent relative standard error (PRSE) of the civilian wage estimate. This specification is run to test if increases in the standard error of the civilian wage estimate cause a bias in the ACOL coefficient. Results for this specification show a positive and significant coefficient for the local ACOL (0.0024) and a negative and significant coefficient for the interaction variable (-0.00008). This result must be interpreted in its entirety with the change in the probability of reenlistment with respect to the ACOL variable (dReen/dACOL) equal to 0.0024 – 0.00008*PRSE. Evaluated at the mean PRSE (4.92) and at 1 standard deviation the mean (8.20), dReen/dACOL is equal to 0.0021 and 0.0018 respectively. This result indicates that increases in the PRSE of the civilian wage estimate cause a downward bias in the ACOL coefficient.

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[88] The local unemployment variable is not included in this model because the measure varies by base by year, which is absorbed with the base by year fixed effect.
[89] The model was also run controlling for the Percent Relative Standard Error of the civilian wage estimate, with a positive and significant result for the local ACOL variable.

Finally, due to the downward bias caused by the PRSE of the civilian wage estimates, Specifications 5 and 6 re-estimate the model replacing the actual local civilian wage with the indexed civilian wage. The indexed wage is advantageous because it eliminates the error bias and computes wage estimates for all occupations across all locations (i.e., no missing data). Results for Specification 5 include all observations in the model, while Specification 6 (for comparative purposes) includes only the observations reporting an actual local civilian wage. Results for both specifications show a positive and significant coefficient for the local ACOL variable (0.0063 and 0.0064) and an insignificant coefficient for the local unemployment variable. The magnitudes of the coefficients are higher in these specifications compared to the previous specification using the actual local civilian wage. Results indicate that the probability of reenlistment rises 0.0065 and 0.0068, respectively, with a $1,000 increase in the local ACOL variable. Specification 6 estimates an ACOL elasticity of reenlistment of 0.145 and the corresponding military wage elasticity of 0.306. Additionally, comparing Specification 2 and 6 shows the indexed civilian wage estimate yields a better fit to the data than the actual civilian wage estimate with a higher respective R-squared value (0.0756 compared to 0.0752).

Table 3-9 shows results for the analysis using only the subset of 58 locations where the Air Force Base is located in a metropolitan area with wage estimates. Results for the ACOL variable remain positive and significant with minor increases in the magnitudes compared to the results when using the entire data set. Additionally, results for the unemployment variable in Specifications 2 and 4 are negative and significant. This result is contrary to they hypothesis that reenlistments should increase with increases

in unemployment. However, further analysis shows that this negative significant result is being driven by a single location (Beale AFB, CA) which has an excessively high average unemployment rate (13.72%) and a below average reenlistment rate (49.7%).[90]

Results in Tables 3-8 and 3-9 show the decision to reenlist is significantly affected by the variation in the military to civilian wage difference across locations. That is, first-term airmen are more likely to reenlist in locations where military wages are more competitive relative to civilian wages. Estimates for the change in the probability of reenlistment with a $1,000 increase in the local ACOL ranged from 0.0009 to 0.0074.

Consequences of Military Wage Disequilibria

The previous analyses show that the decision to reenlist is significantly affected by the variation in military to civilian wages across locations. That is, the probability of reenlistment increases (or decreases), as military wages are more (or less) competitive with civilian wages at the location of assignment. In addition to the reenlistment effects, the current military wage structure may also affect the quality of the personnel being retained in each location.

Under the Air Force Selective Reenlistment Program (SRP), unit commanders[91] must first approve enlisted personnel for reenlistment eligibility, prior to them making their reenlistment decision. The purpose of the SRP is to ensure only qualified personnel are eligible to reenlist. However, manning levels within an organization may influence

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[90] This result was found by systematically running Specification 2 excluding all but one base. The coefficient for the unemployment variable remains negative and significant in all specifications except for when Beale AFB is excluded. In this case the coefficient is positive and insignificant.

[91] The unit commander typically is the Squadron Commander at the location of assignment.

this arbitrary[92] decision made by commanders. That is, commanders in locations with low reenlistment rates (caused by less competitive military wages) may have an incentive to decrease reenlistment eligibility standards in order to boost manning levels. The end result, therefore, may be a decrease in the quality of personnel retained in locations with excessively high turnover.

Individual level data are not available on reenlistment quality (i.e., AFQT scores) across locations; however, the data used in the previous analyses can be used to analyze the local labor market effects on the probability of being eligible to reenlist. That is, does the local variation in military to civilian wages across locations affect the probability of being eligible to reenlist? To test this hypothesis, reenlistment eligibility is analyzed using a fixed effects linear probability model with the following format:

$$\Pr(\text{eligible}_{ijctm}) = \alpha_{jct}(\text{Local ACOL}) + \beta_{ct}(\text{Local Unemployment}) + \pi_{c(t-1)}(\text{Base Reenlistment}) + \phi_{jt} + \gamma_m + \varepsilon ,$$

Where the probability of being eligible to reenlist is a function of the local ACOL ($ACOL_loc = W_{mil\ local} - W_{civ\ local}$), local unemployment, the previous year's base reenlistment rate, and unobserved fixed effects, ϕ_{jt} and γ_m (i.e., occupation by year and command fixed effects) for person i, in occupation j, at base c, in command m, in year t. The fixed effects model is used to control for occupational variation at the national-level (occupation by year fixed effect) and variation across different missions within the Air

[92] There are no specific requirements for reenlistment eligibility. However, commanders are instructed to consider: 1) enlisted performance report (EPR) ratings, 2) Unfavorable information from any substantiated source, 3) the airman's willingness to comply with AF standards, and 4) the airman's ability to meet required training and duty performance levels. Source: Air Force Instructions 36-2606.

Force (command fixed effects), leaving only the reenlistment eligibility variation attributed to the local labor market. Standard errors are clustered by base by occupation.

The model assumes an equal distribution of personnel (within-occupation) across locations according to ability.[93] Results for this model indicate whether or not the local labor market affects the probability of being eligible to reenlistment. The presumption is that locations with significantly higher reenlistment eligibility rates have lower eligibility standards, and thus lower quality personnel retained.[94]

If local labor markets affect reenlistment eligibility, then the local ACOL should have a negative impact on reenlistment eligibility. That is, the probability of reenlistment eligibility should decrease as military wages relative to the civilian wages increase at the location of assignment. The local unemployment variable should have a negative coefficient because fewer airmen should be classified as eligible as local civilian job opportunities decrease. Finally, results for the prior year reenlistment rate are expected to be negative. As prior year reenlistment rates rise, so do manning levels, making reenlistment eligibility more selective.

Results for this analysis are shown in Tables 3-10 and 3-11. Table 3-10 shows the marginal effects coefficients and standard errors for the explanatory variables of interest. Table 3-11 shows the percentage point increase in the probability of being eligible to reenlist associated with a 1 standard deviation increase in the explanatory variable. Specifications 1-4 calculate ACOL using the actual OES civilian wage by metropolitan

[93] This is a reasonable assumption based on the fact that first-term personnel are assigned to locations based on taste preference and needs of the Air Force, not according to ability.
[94] The presumption that lower quality personnel have a higher probability of reenlisting is based on the fact that these personnel have a lower opportunity cost of staying in the

area, while Specifications 5-8 use the indexed civilian wage for the ACOL calculation.[95] All specifications include the local ACOL and unemployment variables, while Specifications 4 and 8 include the prior year base reenlistment rate. Year, AFSC by year, and command fixed effects are progressively added to each specification to further test the model.

Results for the ACOL variable are negative in all specifications and significant at the 0.10-level in all but Specifications 3 and 4.[96] The magnitude of the effects are relatively large with the probability of being eligible to reenlist decreasing between 1.17 and 7.05[97] percentage points (i.e., the probability decreases between 0.0117 and 0.0705) depending on the specification, with a 1 standard deviation increase in the ACOL variable. The unemployment variable is insignificant in all specifications. Finally, the negative and significant results for the previous year's base reenlistment rate in Specifications 4 and 8 indicate that the probability of being eligible to reenlist decreases between 0.77 and 1.36 percentage points with a 1 standard deviation increase in the prior year reenlistment rate.

Results from this analysis indicate that the probability of being eligible to reenlist decreases (or increases) in locations where military wages are more (or less) competitive with civilian wages. Additionally, the probability of reenlistment eligibility decreases as the base's prior year reenlistment rate increases. This provides indirect evidence that the

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military. Saving and Stone (1985) showed this empirically estimating that a 1% increase in AFQT score decreases the probability of reenlisting by 0.144%..

[95] Note: There are 28,859 missing observations in the sample of 132,234 for the specifications using the actual local civilian wage.

[96] The insignificant result for the ACOL variable in Specification 3 is when a command fixed effect is included in the model. The ACOL variable in Specification 4 is significant at the 0.15-level.

standards of reenlistment eligibility are affected by the disequilibria of military and civilian wages at the local level.

Additionally, these results also provide evidence that the coefficients for the ACOL variable in Tables 3-8 and 3-9 are biased toward zero. The negative bias is due to the fact that low quality personnel are more likely to reenlist, and locations with less competitive wages are allowing lower quality personnel the opportunity to reenlist. That is, if reenlistment eligibility standards were the same across all locations, the magnitude of the ACOL variable would likely be higher than the models estimate.

Conclusions

Results from this study show that military wages are not in equilibrium with local civilian labor markets. The cost of living elasticity of military wages is significantly less than civilian wages and military wages are not adjusted for location amenities. The result is an inequitable distribution of military wages across locations.[98] This inequity was shown to significantly affect the reenlistment decision of Air Force first-term personnel from 1996-2001. The probability of reenlistment increased with the local military to civilian wage difference (local ACOL) when controlling for the occupational variation at the national level and controlling for variation across commands and locations.

Additionally, results showed that the probability of being eligible to reenlist increases (or decreases) in locations where military wages are less (or more) competitive with civilian wages. This result indicates that lower quality personnel are likely being retained in the high cost and/or low amenity locations because commanders have an incentive to decrease reenlistment eligibility standards in order to boost manning levels.

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[97] This range excludes the two specifications where the ACOL variable is insignificant.

Furthermore, results from this study indicate that previous retention models have erroneously analyzed the military as a purely national labor market. The decision to reenlist is a function of both the national wage opportunity and the local compensating wage differential.

A major policy implication arises from these results. Geographic equity in military wages can be obtained by restructuring the military pay system to match the compensating variation in local civilian wages and this can be accomplished at no cost to the government.[99] Geographic equity in military wages would result in a more efficient and cost effective military labor force by equalizing the reenlistment rate across locations, resulting in reduced moving costs and decreased turnover within each location.[100]

Further study of the local labor market's effect on reenlistment is warranted. A model controlling for the individual characteristics (i.e., age, race, sex, education, and marital status) of the reenlisting personnel would provide more efficient estimates. Additionally, local civilian wage estimates (if available) should control for differences in education and experience of personnel.

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[98] The inequity is based on the premise that local civilian wages are in full equilibrium and civilian wages provide the basis for which military wages should be adjusted.

[99] The pay adjustments would be redistribution of dollars from locations where military wages are currently more competitive to locations where wages are less competitive compared to civilian wages (i.e., low cost and high amenity locations to high cost and low amenity locations). Additionally, the DoD could actually reduce costs by eliminating the annual contracts for computing Basic Allowance for Housing (BAH) and Cost of Living Allowances (COLA).

[100] Although movement of personnel is necessary for the military to fill overseas manning requirements, less movement would be required to back-fill locations with a lower than average retention rate.

Table 3-1. Air Force CONUS time-on-station Statistics (TOS), enlisted personnel, April 2002

TOS (years)	Personnel	Percent
<1	47,307	24.1%
1-2	47,814	24.3%
2-3	35,000	17.8%
3-4	24,420	12.4%
4-5	12,577	6.4%
5-6	8,458	4.3%
>6	20,858	10.6%

Table 3-2. Air Force reenlistment statistics

Year	Eligible	Reenlist	Percent
1996	18,176	10,185	56.0%
1997	16,730	8,920	53.3%
1998	15,672	7,855	50.1%
1999	13,622	6,268	46.0%
2000	16,240	8,334	51.3%
2001	16,114	8,873	55.1%
Total	96,554	50,435	52.2%

Table 3-3. Reenlistment statistics by AFSC 2-digit, 1996-2001

AFSC 2-Digit	AFSC Title	Eligible	Reenlist	Percent	
1A	Aircrew	1,637	978	59.7%	***
1C	Command/Control	3,286	1,908	58.1%	***
1N	Intelligence	3,411	1,806	52.9%	
1S	Safety	15	14	93.3%	***
1T	Aircrew Ops	970	537	55.4%	**
1W	Weather	883	448	50.7%	
2A	Aero Maint	21,918	11,553	52.7%	
2E	Communications Electronics	4,981	2,241	45.0%	***
2F	Fuels	1,210	626	51.7%	
2G	Logistic Plans	77	63	81.8%	***
2M	Missile Maintenance	875	438	50.1%	
2P	Precision Measurement	315	110	34.9%	***
2R	Maintenance Data Analysis	544	335	61.6%	***
2S	Supply	4,207	2,669	63.4%	***
2T	Transportation/Vehicle Maint	4,499	2,342	52.1%	
2W	Weapons Maintenance	4,729	2,326	49.2%	***
3A	Information Management	3,544	2,374	67.0%	***
3C	Information Systems	5,035	2,507	49.8%	***
3E	Civil Engineering	7,283	3,130	43.0%	***
3H	Historian	10	7	70.0%	
3M	Services	1,589	888	55.9%	***
3N	PA/Band	462	265	57.4%	**
3P	Security Forces	9,330	3,549	38.0%	***
3R	Printing	26	18	69.2%	*
3S	Personnel	2,311	1,619	70.1%	***
3V	Visual Information	584	313	53.6%	
4A-4V	Medical	9,612	5,372	55.9%	***
4Y	Dental	830	469	56.5%	**
5J	Paralegal	328	224	68.3%	***
5R	Chaplain Mgt	166	85	51.2%	
6C	Contracting	358	229	64.0%	***
6F	Finance	1,303	828	63.5%	***
7S	OSI	22	22	100.0%	***
8*, 9*, A7	Special Duty	204	142	69.6%	***
Total		96,554	50,435	52.2%	

Note - * Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 3-4. Regression results, local wages on price level and amenity

Dependent variable	Military Wages	Civilian Wages	ACOL	ACOL
Specification	1	2	3	4
Price level	0.4788***	0.7819***	-0.3075***	
(total)	(0.0344)	(0.0644)	(0.07789)	
Price level				0.2418
(housing and utilities)				(0.1837)
Price Level				-0.8981***
(all other goods)				(0.2263)
January average temperature	0.0011	-0.0410***	0.0398**	0.0341**
	(0.0071)	(0.0147)	(0.0165)	(0.0155)
R-Sqr	0.9598	0.7913	0.7605	0.7654
Observations	21,914	17,628	17,628	17,628

Note - All specifications include an occupation by year fixed effect. Robust standard errors are in parentheses and are clusterd by location.

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 3-5. Regression results: local wages on price level and amenity (subset)

Dependent variable	Military Wages	Civilian Wages	ACOL	ACOL
Specification	1	2	3	4
Price level	0.4782***	0.8069***	-0.3339***	
(total)	(0.04441)	(0.0792)	(0.0976)	
Price level				-0.1248
(housing and utilities)				(0.2726)
Price Level				-0.7750***
(all other goods)				(0.2798)
January average temperature	0.0032	-0.0405**	0.0405*	0.0321
	(0.0087)	(0.0197)	(0.0227)	(0.0240)
R-Sqr	0.9556	0.7866	0.7570	0.7610
Observations	18,941	18,941	18,941	18,941

Note - All specifications include an occupation by year fixed effect. Robust standard errors are in parentheses and are clusterd by location.

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 3-6. Probability of reenlistment, probit marginal effects, national and local wage specifications

Specification	1	2	3	4	5	6
ACOL	0.0010***		0.0012***	0.0011***		0.0013***
(national)	(0.0003)		(0.0004)	(0.0003)		(0.0003)
ACOL		0.0013***			0.0013***	
(local)		(0.0004)			(0.0003)	
Local - National			0.0053**			0.0145***
(military wage)			(0.0027)			(0.0031)
Local - National			-0.0015**			-0.0055***
(civilian wage)			(0.0007)			(0.0013)
Log likeliehood	-52,357	-52,347	-52,342	-66,806	-66,796	-66,766
R-Sqr	0.0003	0.0005	0.0006	0.0004	0.0005	0.0010
Observations	75,665	75,665	75,665	96,554	96,554	96,554
Local civlian wage	NA	Actual	Actual	NA	Indexed	Indexed

Note - Robust standard errors are clustered by location by occupation

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 3-7. Probability of Reenlistment, probit marginal effects, national and local wage specifications (subset)

Specification	1	2	3	4	5	6
ACOL	0.0012***		0.0015***	0.0013***		0.0015***
(national)	(0.0004)		(0.0004)	(0.0003)		(0.0003)
ACOL		0.0013***			0.0016***	
(local)		(0.0004)			(0.0003)	
Local - National			0.0031			0.0122***
(military wage)			(0.0028)			(0.0033)
Local - National			-0.0016**			-0.0057***
(civilian wage)			(0.0008)			(0.0013)
Log likeliehood	-46,788	-46,775	-46,775	-59,174	-59,159	-59,138
R-Sqr	0.0005	0.0008	0.0008	0.0005	0.0007	0.0011
Observations	67,642	67,642	67,642	85,567	85,567	85,567
Local civlian wage	NA	Actual	Actual	NA	Indexed	Indexed

Note - Robust standard errors are clustered by location by occupation

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 3-8. Probability of reenlistment, regression results, local labor market effects

Specification	1	2	3	4	5	6
ACOL	0.0022***	0.0020***	0.0009**	0.0026***	0.0063***	0.0064***
(local)	(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0009)	(0.0012)
Unemployment	-0.0013	-0.0020	NA	-0.0020	-0.0007	-0.0016
(local)	(0.0013)	(0.0013)		(0.0013)	(0.0012)	(0.0015)
Percent error of civilian wage (PE)				-0.0016 (0.0010)		
ACOL*PE				-0.00009** (0.00004)		
R-Sqr	0.0729	0.0752	0.0809	0.0753	0.0740	0.0756
Observations	75,665	75,665	75,665	75,665	96,554	75,665
Local civilian wage	Actual	Actual	Actual	Actual	Indexed	Indexed
Fixed effects[1]	1	1,2	1,3	1,2	1,2	1,2

[1] Fixed effects: 1=AFSC by Year, 2=Command, 3=Base by Year

Note - Robust standard errors are clustered by location by occupation.

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 3-9. Probability of reenlistment, regression results, local labor market effects (subset)

Specification	1	2	3	4	5	6
ACOL	0.0025***	0.0021***	0.0011**	0.0028***	0.0067***	0.0068***
(local)	(0.0004)	(0.0004)	(0.0004)	(0.0005)	(0.0009)	(0.0011)
Unemployment	-0.0020	-0.0031**	NA	-0.0031**	-0.0013	-0.0023
(local)	(0.0015)	(0.0015)		(0.0015)	(0.0013)	(0.0016)
Percent error of civilian wage (PE)				-0.0013 (0.0010)		
ACOL*PE				-0.00010* (0.00006)		
R-Sqr	0.0735	0.0757	0.0811	0.0757	0.0739	0.076
Observations	67,642	67,642	67,642	67,642	85,567	67,642
Local civilian wage	Actual	Actual	Actual	Actual	Indexed	Indexed
Fixed effects[1]	1	1,2	1,3	1,2	1,2	1,2

[1] Fixed Effects: 1=AFSC by Year, 2=Command, 3=Base by Year

Note - Robust standard errors are clustered by location by occupation.

* Significant at the 0.10 level, ** Significant at the 0.05 level, *** Significant at the 0.01 level

Table 3-10. Probability of reenlistment eligibility, local labor market effects

Specification	1	2	3	4	5	6	7	8
ACOL	-0.0019***	-0.0011*	-0.0001	-0.0009	-0.0022***	-0.0069***	-0.0021**	-0.0069***
(local)	(0.0003)	(0.0006)	(0.0005)	(0.0006)	(0.0003)	(0.0011)	(0.0009)	(0.0011)
Unemployment	-0.0011	0.0008	0.0014	0.0012	0.0013	0.0016	0.0011	0.0015
(local)	(0.0021)	(0.0013)	(0.0013)	(0.0015)	(0.0017)	(0.0011)	(0.0011)	(0.0012)
Previous year's base				-0.0010**				-0.0019***
reenlistment rate				(0.0005)				(0.0005)
R-Sqr	0.0028	0.0739	0.0796	0.0733	0.0030	0.0763	0.0864	0.0766
Observations	103,375	103,375	103,375	83,908	132,234	132,234	132,234	107,777
Local civilian wage	Actual	Actual	Actual	Actual	Indexed	Indexed	Indexed	Indexed
Fixed Effects[1]	1	2	2,3	2	1	2	2,3	2

[1] Fixed Effects: 1=Year, 2=AFSC by Year, 3=Command

Note - Standard errors are clustered by location by occupation.

Table 3-11. Eligibility effects with a 1-standard deviation increase in the explanatory variable

Specification	1	2	3	4	5	6	7	8
ACOL								
(local)	-2.07%	-1.17%	-0.08%	-0.95%	-2.23%	-7.05%	-2.18%	-7.05%
Unemployment								
(local)	-0.17%	0.13%	0.22%	0.19%	0.22%	0.27%	0.18%	0.25%
Previous year's base								
reenlistment rate				0.77%				1.36%

CHAPTER 4
OPTIMAL COMPENSATING WAGE FOR MILITARY PERSONNEL

Introduction

Analysis of reenlistments for first-term airmen shows that the geographic variation in the military to civilian wage difference across locations significantly affects the decision to reenlist. That is, the probability of reenlistment increases (or decreases), as military wages become more (or less) competitive with civilian wages at the location of assignment. Military wages have been shown to be more competitive with civilian wages in low cost and/or high amenity locations because military wages are adjusted only for the price of housing, while civilian wages adjust for both the total price level and location amenities.[101] The disequilibria of military and civilian wages across locations leads one to ask, "What is the optimal geographic compensating wage to pay military personnel?"

To answer this question, this paper first analyzes the current military wage structure and shows why the system pays an inequitable and inefficient wage across locations. Second, an alternative wage structure is proposed which yields a more equitable and efficient wage at no cost to the government. The proposed wage structure would lead to a more geographically stabilized force, while lowering moving costs and potentially increasing retention. Third, wage estimates are calculated using the proposed wage structure and retention effects are simulated on first-term Air Force reenlistments from 1996-2001. Finally, the proposed wage structure is compared to the Army's

Targeted Selective Reenlistment Bonus (TRSB) program. The TSRB program pays higher reenlistment bonuses to Army personnel who, in conjunction with their reenlistment, volunteer to serve at an "undesirable" location.

Current Military Wage Structure

The current military wage structure compensates personnel according to their occupation, rank, number of years of service, and for the cost of housing at the location of assignment. Reenlistment bonuses are used as the primary means to stabilize the Air Force manning levels across occupations. Bonuses are given at the time of reenlistment in career fields that have low reenlistment rates. Additionally, special payments such as "aircrew hazardous duty incentive pay" are given to aircrew members as a further compensating differential. For the purposes of this paper, the reenlistment bonus and special payments programs are presumed to be an efficient and effective way to stabilize the force across occupations.[102]

The Department of Defense has also recognized the need to adjust wages according to the cost of living at the location of assignment. Since 1980, the DoD has paid military personnel a location specific housing allowance to help cover the cost of housing, utilities, and rental insurance.[103] Basic Allowance for Housing (BAH) is paid to all personnel not residing in government-owned housing, with "rates established such that members in each pay grade, independent of location, pay approximately the same

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[101] For more information see Chapter 3.

[102] Warner (1981), Lakhani (1988), Asch and Hosek (1999) argue reenlistment bonuses are a cost-effective way of attaining retention goals across military occupations. However, Asch and Hosek (1999 p.31) state, "The added uncertainty (of bonuses) can adversely affect risk-averse personnel, potentially reducing their retention and productivity."

[103] Before 1980, housing allowances varied according to rank and dependency status, but did not vary across duty location.

out-of-pocket (housing) costs."[104] Additionally, since 1997, modest[105] Cost of Living Allowances (COLAs) have been paid in high cost locations. However, COLAs are only paid when the non-housing costs of a location exceed 108% of the national average.[106] As a result, COLAs are only paid to a small percentage of military personnel with 2 of 67 Air Force bases receiving a COLA (Los Angeles AFB, CA and Hanscomb AFB, MA).

Therefore, the current compensation system leads one to conclude that the DoD's measure of geographic wage equity is that all personnel (within the same rank, number of years service, and occupation) should receive equal nominal compensation after covering their costs of housing.[107] However, one must ask whether the current system provides a truly equitable and efficient wage for military members across locations of assignment?

With regards to issue of equity, military wages, compared to civilian wages, don't fully adjust for the cost of living and amenities at each location. As evidence, regressions of military and civilian wages on the price level and amenities showed that, "military wages compared to civilian wages are less elastic with respect to the price level and are not adjusted downward for positive amenities (Chapter 2, p.17)." That is, military personnel stationed in high cost and/or low amenity locations are paid a lower relative wage compared to personnel stationed in low cost and/or high amenity locations.

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[104] Information reference from http://militarypay.dtic.mil/pay/bah/index.html

[105] For example in 2001, junior enlisted personnel received $19 per month in COLA in Los Angeles.

[106] For more information regarding COLA computations reference: http://www.dtic.mil/perdiem/ccola.html.

[107] Housing standards for each rank are set at comparable housing standards for civilian personnel with similar income levels. For more information on housing standards and BAH computation reference http://www.dtic.mil/perdiem/bah.html.

This equity analysis uses civilian compensating wage differentials as the "yardstick" for measuring equity. Civilian wages, I would argue, are a better measure than housing costs because of the equilibrium nature in which civilian wages are adjusted. That is, civilian wages adjust from the national average (by occupation) to keep workers indifferent between locations. For example, wages in "desirable" locations are lower (while simultaneously adjusting for the price level) because persons are willing to accept a lower wage for living in these locations.

The current military wage system also creates inefficiencies in the Air Force labor force. Reenlistment rates vary significantly across locations because the opportunity cost for staying in the Air Force varies from location to location.[108] Unequal reenlistment rates lead to production inefficiency caused by short-term manning shortages (or surpluses) in locations with excessively high (or low) turnover. Analysis has also shown that Air Force bases with low reenlistment rates are likely to have a lower overall quality workforce.[109] Additionally, locations with high turnover and manning shortages place an added work burden on those personnel who remain and serve. This added work burden could be considered a "tax" on personnel, thus perpetuating the low reenlistment rate at that location. Finally, the added need to move personnel to balance manning requirements causes additional inefficiencies by increasing the DoD's moving

[108] Retention is also affected by the differences in missions across locations. However, analysis of reenlistments in Chapter 2 controlled for this variation by including command and base fixed effects.

[109] Results from Chapter 2 showed that the probability of being eligible to reenlist increases with previous year's base reenlistment rate and decreases as military wages increase relative to civilian wages. Assuming a uniform distribution of personnel across locations according to "ability", these results indicate that locations with higher turnover are likely to have lower quality standards when determining reenlistment eligibility.

expenses.[110] To help combat this problem, the Air Force implemented the Voluntary Stabilized Base Assignment Program (VSBAP), which offers stabilized tour lengths of 4 to 5 years in locations with historically high turnover. Current VSBAP locations include: Los Angeles, CA, Minot AFB, ND, Grand Forks AFB, ND, Cannon AFB, NM, and Limestone, AFB, ME. All of these locations are either high cost (Los Angeles) or arguably (the other 4 locations) low amenity locations.

Inefficiencies are further compounded by the need to send personnel to "undesirable" locations on a non-voluntary basis. Air Force manning requirements are first filled on a volunteer basis, however, when there is not enough eligible volunteers the Air Force must give "non-volunteer" assignments to personnel. This non-voluntary system of assignments is inefficient for the same reasons the military draft was inefficient.[111] That is, those personnel who are assigned to a location on a non-voluntary basis are not necessarily those with the lowest opportunity cost for serving at that location (based on non-pecuniary taste preferences). In essence, non-volunteers pay a "tax" equal to their disutility from serving at an undesirable location.

However, if wages were set at the level required to induce enough volunteers, then the total opportunity cost of persons serving at each location would be minimized. Figure 4-1 graphically depicts this relationship for locations with not enough

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[110] Movement of personnel is necessary in the DoD due to the rotational system of overseas assignments. However, in FY99 the Air Force expended $60.8 million in "Enlisted Operational Travel (EOT), which is primarily CONUS to CONUS movement of personnel. Theses EOT expenses could be reduced with a more stabilized force across locations.

[111] See Fisher (1969) and Warner and Asch (2001).

volunteers.[112] W_R represents the wage required to induce enough volunteers to meet the total labor requirement, L_R. Area A+B+C under the supply curve represents the opportunity costs for persons who would serve voluntarily at that wage. However, the actual military wage, W_A, induces L_A volunteers, which is less than the total labor requirement, L_R. Therefore, the Air Force must non-volunteer (L_R - L_A) personnel to serve. Each of the non-volunteers opportunity cost lies above the supply curve (otherwise they would have volunteered), with the average depicted by AOC. The area A+B+C+D+E represents the total opportunity cost for those serving at wage, W_A, which will always be greater than or equal to that for personnel serving under the all-volunteer wage, W_R.

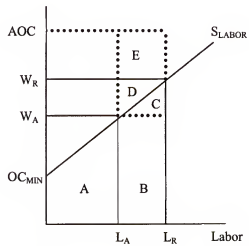

Figure 4-1. Inefficiency for locations without enough volunteers

The opposite case is true in locations where there are too many volunteers. In desirable locations, the DoD has set the wage above the level required to induce the needed number of volunteers. This situation also leads to inefficiencies because wages

[112] Warner and Asch (1999) used this graphical analysis to portray the inefficiencies of the military draft.

could be lowered while still inducing enough volunteers to meet manning requirements. Figure 4-2 graphically depicts this relationship for locations with too many volunteers. W_R represents the wage required to obtain the needed number of volunteers, L_R. The area A under the supply curve represents the total opportunity cost for personnel who would serve at this wage. However, the DoD pays wage, W_A, inducing L_A volunteers, which is greater than the labor requirement, L_R. With too many volunteers, the Air Force must randomly choose among these volunteers. The resulting opportunity cost for personnel serving at wage L_A, will be a convex combination of areas A and B, which will always be greater than or equal to the opportunity cost for those who would have served at wage, W_R.

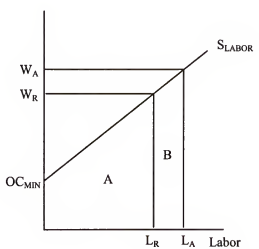

Figure 4-2. Inefficiency for locations with too many volunteers

This analysis shows that the current wage system leads to inefficiencies by not minimizing the opportunity costs of personnel serving at each location. However, one might argue that opportunity cost inefficiency is irrelevant because military personnel, with time remaining on their enlistment, must serve at their assigned location regardless

of taste preference. However, personnel who are assigned at a location on a non-voluntary basis likely have lower morale and thus reenlist at a lower rate.[113] Additionally, approximately 2,000[114] Air Force personnel per year, without sufficient time on their enlistment, decline a non-voluntary assignment and choose to exit the Air Force.[115]

Proposed Wage Structure

The preceding theory indicates that the current military wage structure is both inequitable and inefficient. The "first best" solution to this problem would be to establish wages such that the exact number of personnel required at each location would volunteer. Such a wage structure would minimize the total opportunity costs for personnel serving at each location and would lead to more stabilized force by equalizing reenlistment rates across locations. Unfortunately, such a wage would be difficult to determine because the preferences of military personnel are not known.

However, civilian preferences for locations are approximately known through civilian compensating wage differentials. As a "second best" alternative, military wages could be set according to civilian taste preferences. Such a wage would result in military to civilian wage equity across locations, leading to a more stabilized force, as the opportunity cost of staying in the military would be the same regardless of where personnel are assigned. Additionally, this wage structure would result in better sorting of military personnel across locations, because more personnel would volunteer to serve in

[113] This hypothesis would need to be verified through an empirical analysis. However, currently no data are unavailable to test the notion.
[114] Statistic obtained from the Air Force Personnel Center, Enlisted Assignments Branch. This represents approximately 3.3% of all enlisted personnel who receive an assignment (voluntary or non-voluntary) in a given year.

the high cost and/or low amenity locations. The end result would be fewer non-volunteer assignments and lower opportunity costs for personnel serving at each location.

Adjusting military wages according to civilian compensating wage differentials makes the implicit assumption that military and civilian taste preferences for locations are the same. Although actual taste preferences of military personnel are not known, this assumption appears to be reasonable when using "home of record" as a proxy for military personnel's regional taste preference.[116] Table 4-1 shows the regional distribution of Air Force recruits from Fiscal Year (FY) 1992-FY97 and compares this to the distribution of assignments for first-term reenlisting personnel stationed in the United States from FY96 to FY01.[117] Table 4-1 shows that the regional distributions of recruits and assignments are somewhat similar. A majority recruits (50.3%) are from the South and approximately the same proportion (51.7%) are assigned to locations in the South. Distribution of recruits and assignments, respectively, across the other three regions are 19.0% and 36.8% for the West, 16.0% and 2.4% for the Northeast and 13.9% and 9.2% for the Midwest. Therefore, recruits from the Northeast and Midwest are transferred to the West.[118]

A second assumption in adjusting wages according to civilian compensating wage differentials is that location patterns of military and civilian employment are the same. That is, the supply and demand relationship for military and civilian labor is

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[115] Unfortunately, there is no way to determine if these personnel would have exited the military without receiving the assignment.

[116] Using a member's home of record as a proxy for regional taste preference only accounts for regional characteristics of locations and does not account for preferences such as city size, etc.

[117] Recruits from FY92-FY97 approximate the cohort of personnel reenlisting from FY96-FY01.

similar across locations. This assumption is less likely to hold because many Air Force bases are located in rural areas where the civilian population is relatively small compared to the military population. In such locations, civilian compensating wage differentials may under estimate the wage required to induce the needed number of volunteers. This may occur because civilian wages do not have to be very high in low populace areas because there is no need to attract a lot of people to live there. Table 4-2 shows the population, number of military personnel, and percentage of military personnel for each Air Force base.[119] The number of military personnel as a percentage of the total population ranges from 0.03% in Los Angeles, CA to 10.8% in Fayetteville, NC, with an average of 1.81% and a standard deviation of 1.93%. In locations with a high proportion of military personnel, civilian compensating wage differentials may not be a fully accurate measure of the wage required to induce enough volunteers. To partially correct for this problem, civilian wage estimates from the nearest small metropolitan area are used to calculate the civilian compensating wage differentials for bases in rural locations. Using wage estimates from the nearest metropolitan area with similar characteristics[120] likely adjusts wages upward compared to the actual local civilian wages, but does not adjust wages for any amenities or disamenities associated with living in that rural location.

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[118] This assumes recruits have a preference for staying in their home of record region.
[119] Civilian populations are for the respective MSA. If the base is not located in an MSA, the respective County population is shown. The military population includes the number of personnel from all the military branches of service. Also note that in several locations (i.e., San Antonio and Washington D.C.) there is more than one Air Force base.
[120] The replacement metropolitan areas were chosen based on distance, size, and geographic characteristics (i.e., proximity to coast, mountains, etc.).

In order to adjust military wages according to civilian compensating wage differentials, civilian wages across locations must be known. Fortunately, since 1997, the Bureau of Labor and Statistics (BLS) have collected wage data for 330+ metropolitan areas across 700+ occupations.[121] These data, therefore, can be used to measure the compensating differential for each location by comparing relative wages in each location (by occupation) to the national average wage. A location specific wage index is computed by summing the weighted averages of the ratio of the local to national wage for each occupation. The index is computed as follows:

$$I_t = \Sigma_t \alpha^i_t / \beta_t * (W^i_t / N^i), \text{ where,}$$

I_t = Wage index for location, t

α^i_t = # of persons employed in occupation, i at location, t

β_t = Total # of persons employed at location, t

W^i_t = Wage for occupation, i at location, t

N^i = National average wage for occupation, i

Table 4-3 shows the average civilian wage index from 1997-2000 for the 67 Air Force bases located in the United States. For comparative purposes a similar wage index is shown for military wages in each location.[122] [123] Of note is the relatively tighter

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[121] The data collected by the BLS is referred to as the Metropolitan Area Occupational Employment and Wage Estimates. For more information reference: http://www.bls.gov/oes/oes_ques.htm.

[122] The local wages used to calculate the military wage index include Base Pay, BAH, BAS, COLA, and the tax advantage from not paying income tax on BAH or BAS. The national military wage replaces BAH with BAH II and does not include a COLA. BAH II is the "national" housing allowance given to personnel who are in transit from overseas assignments. Reenlistment bonuses and special payments are not included because these rates are occupational specific at the national level.

[123] Fifty-eight of the 67 bases are located in a metropolitan area with OES wage estimates. Estimates for the remaining 9 bases use OES wages for the nearest small

distribution of the military wage indexes compared to civilian wage indexes across locations as indicated by the smaller standard deviation of the military wage index (0.067) compared to the civilian wage index (0.095).

The civilian wage index can then be used to adjust military wages across locations. This is accomplished by multiplying the civilian wage index by the national military wage.[124] [125] Table 4-4 shows the average indexed military wage (monthly wage excluding reenlistment bonuses and special payments) for each location from 1996-2001 and compares this to the average military wage for each location under the current system.

The proposed wage structure makes the adjustments such that the total military pay expenditure is constant across the 6-year period of the analysis. The result is a transfer of wages from low cost and/or high amenity locations to high cost and/or low amenity locations with the purpose of equalizing the military to civilian wage differences across locations. Table 4-5 shows the standard deviation of the military to civilian wage difference (annual in thousands) for all occupations and locations under the current military wage structure and the proposed wage structure. Row 1 computes the standard deviations using the actual local civilian wage (by occupation), and Row 2 uses the

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metropolitan area. Appendix F lists the Air Force bases, locations, and the OES wage estimate metropolitan area.

[124] After multiplying the national military wage by the civilian wage index, wages were then multiplied by a factor of 1.133257816. This was done in order to keep total military wage expenditures constant.

[125] Reenlistment bonuses and special payments are then added back into this wage to calculate the occupational specific wage. Bonuses and special payments were not adjusted by the civilian wage index because they are assumed to be an efficient way to stabilize reenlistment rates across occupations at the national level.

indexed civilian wage.[126] In both cases, the standard deviation for the proposed wage structure is less than that of the current wage structure.[127] These results indicate that the proposed wage structure results in less variation in the military to civilian wage difference across locations.[128]

Next, the proposed wage structure is used to simulate Air Force first-term reenlistment effects from 1996-2001. The simulations only estimate the short-term reenlistment effects from changing the wage structure and do not estimate the long-term effects attributed to better sorting (i.e., how personnel would change their decision to volunteer for a location), decreased turnover, and lower moving costs.

Reenlistment Simulations of Proposed Wage Structure

Using the proposed military wage structure, reenlistment effects are simulated using Specifications 5, Table 3-8 in Chapter 2. To calculate the simulated effect on reenlistment, the predicted probability of reenlistment under the current wage structure is subtracted from the predicted probability of reenlistment under the proposed wage structure. The difference in these two predicted probabilities are then summed to show the total change in reenlistment from changing the wage structure. Additionally, the wages have been set such that the annualized cost to the DoD from the change in the wage structure is zero.

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[126] The military to civilian wage difference is the Annualized Cost of Leaving (ACOL) for a four-year reenlistment. Refer to Chapter 2 for more information regarding the computation of ACOL.

[127] The standard deviation will not be zero because reenlistment bonuses and special payments are not adjusted by the location wage index.

[128] A similar analysis was conducted by AFSC at the 2-digit and 6-digit level. Results at the AFSC 2-digit level showed smaller standard deviations for the proposed wage in 80.4% and 98.2%, respectively for the actual and indexed civilian wages. Results at the AFSC 6-digit level showed smaller standard deviation in 69.4% and 94.1%, respectively

Due to the linearity[129] of the retention model, a zero change in total wages results in a zero change in reenlistment. Therefore, the measure of "effectiveness" of the proposed wage structure is whether or not reenlistment rates equalize across locations. As the measure of "effectiveness" the analysis sums the squared deviations of the base reenlistment rates from the overall Air Force reenlistment rate.[130] This value is then compared before and after the wage change, with a lower sum of squared deviations indicating a more equalized reenlistment rate.

Tables 4-6 and 4-7 show results from this analysis. Table 4-6 shows results for all occupations and locations and Table 4-7 shows results for selected AFSCs at the 2-digit level.

Results in Table 4-6 indicate that the proposed wage structure better equalizes reenlistment rates across locations as shown by a lower sum of squared deviations for the proposed wage structure (13.6%) compared to the current wage structure (15.0%).

Next, Table 4-7 shows similar results for the Aviation Maintenance, Civil Engineering, and Security Forces occupations. For the Aviation Maintenance career field, the proposed wage structure results in net gain of nearly 5 reenlistments and a sum of squared deviations of 177.4% compared to 180.1% for the current wage structure. For the Civil Engineering career field, the proposed wage structure results in a net gain of nearly 2 reenlistments and a sum of squared deviation of 25.5% compared to 25.6% for

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for the actual and indexed civilian wages. Results for these analyses are available upon request from the author.

[129] The simulation was also conducted using a non-linear (Probit) model. Results were similar with a zero change in reenlistment associated with a zero change in overall wages.

[130] The squared difference is preferred to the absolute value of the difference because the squared measure applies more (negative) weight to locations with excessively high or low reenlistment rates.

the current wage structure. Finally, for the Security Forces career field, the proposed wage structure results in a net loss of 4 reenlistments and a sum of squared deviation of 34.2% compared to 37.8% for the current wage structure.

Results from these analyses indicates that the proposed wage structure would lead to more equalized reenlistment rates across locations, without affecting the overall reenlistment rate or increasing wage expenditure to the government. More equalized reenlistment rates lead to production efficiency by stabilizing manpower levels across locations and would reduce the overall moving costs of the government. Additionally, because the proposed wage structure matches civilian compensating wage differentials, the long-term effect would be better geographic sorting of personnel according to taste preferences, thus, minimizing the total opportunity cost of personnel serving at each location.

The Army's TSRB Program

The Army has taken measures to rectify problems with geographic sorting of personnel and in 1999 began paying additional reenlistment bonuses to members who volunteer to serve in locations with low manning levels (within the respective rank and occupation). The Army's Targeted Selective Reenlistment Bonus (TSRB)[131] program was implemented to help stabilize manning levels across locations, by inducing personnel to volunteer to serve in hard to fill locations. Under the TSRB program, members can receive an additional reenlistment bonus for volunteering to serve at a specified location in conjunction with their decision to reenlist. The amount of the bonus depends on the

[131] The TSRB program is part of the Army's Selective Reenlistment Bonus Program (SRB) and is commonly referred to as the SRB/TSRB program.

individual's rank, occupation[132], years-of-service, length of reenlistment, and the location they volunteer to serve. For example, currently, a Sergeant (E-5) in the Infantry with 4 years of service would receive an additional reenlistment bonus of $3,657 with a 4-year reenlistment to Fort Drum, NY.[133]

The Army varies the bonus amounts on a quarterly basis depending on current manning levels and projected requirements. The total cost of the SRB/TSRB program was over $112 million in FY01, $89 million in FY02, and is projected to be over $110 million in FY03.[134] However, because the SRB and TSRB budget figures are combined, it is unknown how much was spent on the TSRB program alone.

This program, on the surface, appears to be an effective way to induce volunteers to serve at "undesirable" locations. However, an extensive analysis of the program would be needed in order to determine if the program is an efficient and cost-effective way to stabilize manning levels across locations.[135] One potential concern of the program is the large number of changes in the bonus offerings from quarter-to-quarter. For example, from July 2002 to October 2002 the Army made 181 changes to SRB/TSRB

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[132] Occupation refers to the Military Occupational Specialty (MOS), Additional Skill Identifiers (ASI), and Specialty Qualification Identifiers (SQI).

[133] Calculation of the bonus is based on the 2002 Military Pay Table and the October 2002 SRB/TSRB bonus multiples (MILPER MESSAGE NUMBER: 02-255). The total reenlistment bonus for the individual would be approximately $10,971, of which $3,657 is given for volunteering to serve at Fort Drum, NY. The amount of the bonus is computed by multiplying the Bonus Multiple (1.5) by the monthly Base Pay ($1,828.5) by the number of years of reenlistment (4). The same individual would receive a bonus of $7,314 for a four-year reenlistment without volunteering to go to Fort Drum. The bonus is paid 50% upon reenlistment with the remaining 50% paid annually over the next 3 years. The TSRB program requires personnel to serve a minimum of 2 years at the specified location. Total SRB/TSRB payments are capped at $40,000.

[134] Figures from Department of the Army, FY03 Budget Estimates, submitted to Congress, February 2002.

bonus multiples across all occupations and locations.[136] Also, concern arises from the potential adverse affects associated the uncertainty of future bonuses with risk-averse personnel (Asch and Hosek, 1999).

Compared to the proposed wage structure set forth in this paper, the TSRB program has the possible advantage of increasing reenlistment rates, while simultaneously inducing personnel with the lowest opportunity cost to serve in undesirable locations. However, this potential gain comes with the added cost of paying the bonus. Additionally, it is unknown if these same personnel would reenlist without the bonus and then volunteer to serve in that same location (under the proposed wage structure).

The Army's SRB/TSRB program appears to have a clear advantage over the Air Force's SRB program. The Air Force SRB program only varies reenlistment bonuses at the national level, and, therefore, provides no incentive for personnel to volunteer to serve at the undesirable locations. The Air Force SRB program increases the overall reenlistment rate, but does not help solve the geographic sorting problem. However, the Army's program provides a partial mechanism to sort personnel. That is, those personnel who choose to accept a TSRB, are those reenlisting personnel who have the lowest opportunity cost for serving at that location (among the eligible reenlisters).

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[135] The author requested and was unable to obtain the data necessary to complete such a study.

[136] Due to the discreteness of the bonus multiples (0, 0.5, 1.0, etc.) the changes in bonus amounts from quarter-to-quarter are relatively large, with a minimum change of approximately $2,276 (rank E-4, 3-year reenlistment, and 0.5 change in the bonus multiple). Additionally, the referenced 181 changes do not include the number of changes made within each rank or term of reenlistment. Finally, the large number of changes is a consistent trend over time with 189 changes made from April 2002 to June 2002. Data obtained from MILPER MESSAGES 02-225 and 02-174.

Conclusions

The current military pay structure pays inequitable and inefficient wages across locations. Military personnel are paid less competitive wages in high cost and/or low amenity locations compared to low cost and/or high amenity locations. This pay system results in unequal reenlistment rates across locations, which leads to production inefficiencies caused by short-term manning shortages in excessively high-turnover locations. Additionally, because wages are not set at the level required to induce enough volunteers to serve in each location the total opportunity cost for personnel serving in each location is not minimized.

As a second best solution, wages should be set according to civilian compensating wage differentials. Such a wage would result in a more a more stabilized force (across locations) by equalizing the opportunity cost of staying in the Air Force at each location. Additionally, more personnel would volunteer to serve in the high cost and/or low amenity locations because wages would be more commensurate with civilian taste preferences. This would result in fewer non-volunteer assignments to undesirable locations and a minimized opportunity cost for personnel serving at each location. Additionally, overall moving expenses would decrease because there would be less of a need to backfill locations.

Reenlistment simulations showed that the proposed wage structure would better equalize reenlistment rates across locations, and this could be at no cost to the government.

Finally, the Army has recognized the problem of geographic compensating differentials and pays additional reenlistment bonuses to personnel who volunteer to

serve in "undesirable" locations. Further study of this program would show if this is an efficient and cost-effective way to stabilize manning levels across locations.

Table 4-1. Home of record locations and CONUS assignments

Region	Recruits	Percent	Assignments	Percent
Midwest	26,042	13.9%	12,123	9.2%
Northeast	29,980	16.0%	3,200	2.4%
South	94,279	50.3%	68,301	51.7%
West	35,582	19.0%	48,610	36.8%
Unknown	1,378	0.7%	-	0.0%
Total	187,261	100.0%	132,234	100.0%

Table 4-2. Civilian and military population

Base	Location	Civlian Population (Thous)	Military Population (Thous)	% Military
Altus AFB, OK	Altus, OK	28.6	0.8	2.64%
Andrews AFB, MD	Washington, DC	7,255.7	39.4	0.54%
Barksdale AFB, LA	Shreveport, LA	385.9	4.5	1.17%
Beale AFB, CA	Yuba County, CA	132.5	1.6	1.19%
Bolling AFB, VA	Washington, DC	7,255.7	39.4	0.54%
Brooks AFB, TX	San Antonio,TX	1,485.3	20.6	1.39%
Cannon AFB, NM	Clovis, NM	43.9	1.2	2.66%
Charleston AFB, SC	Charleston, SC	532.2	5.1	0.96%
Columbus AFB, MS	Columbus, MS	60.7	0.8	1.35%
Davis-Mothan AFB, AZ	Tucson, AZ	773.0	4.9	0.63%
Dover AFB, DE	Dover, DE	120.4	2.2	1.82%
Dyess AFB, TX	Abilene, TX	123.8	3.2	2.56%
Edwards AFB, CA	Kern County, CA	118.3	1.3	1.12%
Eglin AFB, FL	Fort Walton Beach, FL	159.8	11.0	6.89%
Eielson AFB, AK	Fairbanks, AK	80.8	2.3	2.87%
Ellsworth AFB, SD	Rapid City, SD	85.7	1.3	1.48%
Elmendorf AFB, AK	Anchorage, AK	246.7	5.7	2.33%
F.E. Warren AFB, WY	Cheyenne, WY	78.2	2.5	3.14%
Fairchild AFB, WA	Spokane, WA	395.3	1.8	0.46%
FT Meade, MD	Baltimore, MD	7,255.7	4.9	0.07%
Goodfellow AFB, TX	San Angelo, TX	101.8	1.4	1.38%
Grand Forks AFB, ND	Grand Forks, ND	99.8	1.1	1.09%
Hanscom AFB, MA	Boston, MA	5,673.6	1.3	0.02%
Hickam AFB, HA	Honolulu, HI	860.2	15.4	1.79%
Hill AFB, UT	Ogden, UT	1,229.2	3.0	0.24%
Holloman AFB, NM	Alamagordo, NM	58.2	1.7	2.88%
Hurlburt Field, FL	Fort Walton Beach, FL	159.8	11.0	6.89%
Keesler AFB, MS	Biloxi, MS	343.3	5.1	1.49%
Kelly AFB, TX	San Antonio, TX	1,485.3	20.6	1.39%
Kirtland AFB, NM	Albuquerque, NM	663.3	2.8	0.42%

(continued next page)

Table 4-2. Continued

Base	Location	Civlian Population (Thous)	Military Population (Thous)	% Military
Lackland AFB, TX	San Antonio, TX	1,485.3	20.6	1.39%
Langley AFB, VA	Hampton, VA	1,519.0	13.7	0.90%
Laughlin AFB, TX	Del Rio, TX	42.4	0.5	1.29%
Little Rock AFB, AR	Little Rock, AK	555.6	3.3	0.60%
Los Angeles AFB, CA	Los Angeles, CA	15,636.8	4.8	0.03%
Luke AFB, TX	Phoenix, AZ	2,846.5	5.8	0.20%
MacDill AFB, FL	Tampa, CA	2,264.8	6.0	0.26%
Malmstrom AFB, MT	Great Falls, MT	79.3	2.1	2.60%
Maxwell AFB, AL	Montgomery, AL	316.8	3.8	1.21%
McChord AFB, WA	Tacoma, WA	655.0	12.6	1.92%
McClellen AFB, CA	Sacramento, CA	1,670.6	1.3	0.08%
McConnell AFB, KS	Wichita, KS	521.2	2.1	0.41%
McGuire AFB, NJ	Trenton, NJ	412.1	2.7	0.65%
Minot AFB, ND	Minot, ND	58.4	1.7	2.95%
Moody AFB, GA	Valdosta, GA	85.7	3.2	3.79%
Mountain Home AFB, ID	Mountain Home, ID	26.0	2.1	8.25%
Nellis AFB, NV	Las Vegas, NV	1,279.1	5.8	0.46%
Offutt AFB, NE	Omaha, NE	686.0	5.4	0.79%
Patrick AFB, FL	Cape Canaveral, FL	445.3	1.2	0.27%
Pentagon, DC	Washington, DC	7,255.7	39.4	0.54%
Peterson AFB, CO	Colorado Springs, CO	469.0	18.9	4.02%
Pope AFB, NC	Fayetteville, NC	291.6	29.4	10.08%
Randolph AFB, TX	San Antonio, TX	1,485.3	20.6	1.39%
Robins AFB, GA	Macon, GA	309.9	3.9	1.25%
Scott AFB, IL	St. Louis, MO	2,559.2	4.4	0.17%
Seymour Johnson AFB, NC	Goldsboro, NC	109.9	2.7	2.42%
Shaw AFB, SC	Sumter, SC	103.8	2.6	2.54%
Sheppard AFB, TX	Wichita Falls, TX	136.5	3.2	2.37%
Shriever AFB, CO	Colorado Springs, CO	469.0	18.9	4.02%
Tinker AFB, OK	Oklahoma City, OK	1,033.5	7.6	0.73%
Travis AFB, CA	Fairfield, CA	372.9	3.9	1.05%
Tyndall AFB, FL	Panama City, FL	139.7	3.3	2.37%
US Air Force Academy, CO	Colorado Springs, CO	469.0	18.9	4.02%
Vance AFB, OK	Enid, OK	57.4	0.9	1.51%
Vandenberg AFB, CA	San Luis Obispo Cty	234.9	1.1	0.46%
Whiteman AFB, MO	Johnson County	1,698.8	1.8	0.11%
Wright-Patterson AFB, OH	Dayton, OH	950.8	4.4	0.46%

Table 4-3. Civilian and military wage indexes

Base	Civilian Index	Military Index
Altus AFB, OK	0.87	1.00
Andrews AFB, MD	1.08	1.19
Barksdale AFB, LA	0.87	1.03
Beale AFB, CA	1.00	1.05
Bolling AFB, VA	1.08	1.19
Brooks AFB, TX	0.90	1.07
Cannon AFB, NM	0.85	0.99
Charleston AFB, SC	0.89	1.04
Columbus AFB, MS	0.89	1.00
Davis-Mothan AFB, AZ	0.91	1.08
Dover AFB, DE	0.95	1.09
Dyess AFB, TX	0.84	1.01
Edwards AFB, CA	1.08	1.07
Eglin AFB, FL	0.88	1.04
Eielson AFB, AK	1.16	1.19
Ellsworth AFB, SD	0.87	1.03
Elmendorf AFB, AK	1.16	1.22
F.E. Warren AFB, WY	0.86	1.02
Fairchild AFB, WA	1.00	1.05
FT Meade, MD	1.02	1.18
Goodfellow AFB, TX	0.84	1.00
Grand Forks AFB, ND	0.90	1.01
Hanscom AFB, MA	1.13	1.20
Hickam AFB, HA	1.10	1.28
Hill AFB, UT	0.95	1.06
Holloman AFB, NM	0.83	1.00
Hurlburt Field, FL	0.88	1.04
Keesler AFB, MS	0.88	1.05
Kelly AFB, TX	0.90	1.07
Kirtland AFB, NM	0.92	1.08
Lackland AFB, TX	0.90	1.07
Langley AFB, VA	0.90	1.06
Laughlin AFB, TX	0.84	1.00
Little Rock AFB, AR	0.90	1.02
Los Angeles AFB, CA	1.08	1.21
Luke AFB, TX	0.97	1.09
MacDill AFB, FL	0.93	1.10
Malmstrom AFB, MT	0.85	1.00
Maxwell AFB, AL	0.88	1.03
McChord AFB, WA	1.08	1.08
McClellen AFB, CA	1.08	1.09
McConnell AFB, KS	0.94	1.03
McGuire AFB, NJ	1.15	1.16
Minot AFB, ND	0.87	0.99
Moody AFB, GA	0.88	1.02
Mountain Home AFB, ID	0.93	1.02
Nellis AFB, NV	1.07	1.14
Offutt AFB, NE	0.94	1.05
Patrick AFB, FL	0.90	1.06
Pentagon, DC	1.08	1.19
Peterson AFB, CO	0.97	1.08
Pope AFB, NC	0.88	1.05
Randolph AFB, TX	0.90	1.07
Robins AFB, GA	0.90	1.06
Scott AFB, IL	1.00	1.03
Seymour Johnson AFB, NC	0.85	1.03
Shaw AFB, SC	0.84	1.01
Sheppard AFB, TX	0.86	1.02
Shriever AFB, CO	0.97	1.08
Tinker AFB, OK	0.89	1.01
Travis AFB, CA	1.09	1.16
Tyndall AFB, FL	0.85	1.05
US Air Force Academy, CO	0.97	1.08
Vance AFB, OK	0.82	1.00
Vandenberg AFB, CA	1.03	1.13
Whiteman AFB, MO	0.99	1.00
Wright-Patterson AFB, OH	1.00	1.04
Standard Deviation	0.095	0.067

Table 4-4. Proposed wages (monthly average, 1996-2001)

Base	Actual Wages	Proposed Wages	Change
Altus AFB, OK	2,164	1,988	176
Andrews AFB, MD	2,581	2,633	(52)
Barksdale AFB, LA	2,242	2,106	136
Beale AFB, CA	2,279	2,491	(212)
Bolling AFB, VA	2,581	2,633	(52)
Brooks AFB, TX	2,323	2,211	112
Cannon AFB, NM	2,160	2,067	93
Charleston AFB, SC	2,272	2,178	95
Columbus AFB, MS	2,164	2,151	13
Davis-Mothan AFB, AZ	2,342	2,225	117
Dover AFB, DE	2,363	2,343	20
Dyess AFB, TX	2,201	2,035	166
Edwards AFB, CA	2,324	2,620	(296)
Eglin AFB, FL	2,268	2,167	100
Eielson AFB, AK	2,581	2,838	(257)
Ellsworth AFB, SD	2,232	2,127	106
Elmendorf AFB, AK	2,654	2,838	(185)
F.E. Warren AFB, WY	2,213	2,080	132
Fairchild AFB, WA	2,271	2,498	(226)
FT Meade, MD	2,565	2,504	61
Goodfellow AFB, TX	2,172	2,010	162
Grand Forks AFB, ND	2,195	2,181	14
Hanscom AFB, MA	2,622	2,798	(176)
Hickam AFB, HA	2,778	2,636	142
Hill AFB, UT	2,307	2,339	(32)
Holloman AFB, NM	2,165	1,968	198
Hurlburt Field, FL	2,268	2,167	100
Keesler AFB, MS	2,289	2,110	178
Kelly AFB, TX	2,323	2,211	112
Kirtland AFB, NM	2,352	2,233	119
Lackland AFB, TX	2,323	2,211	112
Langley AFB, VA	2,298	2,230	69
Laughlin AFB, TX	2,178	2,010	168
Little Rock AFB, AR	2,212	2,182	31
Los Angeles AFB, CA	2,642	2,620	22
Luke AFB, TX	2,365	2,377	(12)
MacDill AFB, FL	2,386	2,302	84
Malmstrom AFB, MT	2,163	2,055	108
Maxwell AFB, AL	2,241	2,185	56
McChord AFB, WA	2,337	2,685	(348)
McClellen AFB, CA	2,375	2,682	(306)
McConnell AFB, KS	2,238	2,375	(136)
McGuire AFB, NJ	2,516	2,840	(324)
Minot AFB, ND	2,141	2,112	29
Moody AFB, GA	2,221	2,189	32
Mountain Home AFB, ID	2,220	2,276	(57)
Nellis AFB, NV	2,474	2,595	(121)
Offutt AFB, NE	2,274	2,334	(60)
Patrick AFB, FL	2,302	2,238	64
Pentagon, DC	2,581	2,633	(52)
Peterson AFB, CO	2,345	2,403	(58)
Pope AFB, NC	2,286	2,163	124
Randolph AFB, TX	2,323	2,211	112
Robins AFB, GA	2,300	2,192	109
Scott AFB, IL	2,236	2,475	(238)
Seymour Johnson AFB, NC	2,239	2,041	198
Shaw AFB, SC	2,204	2,078	126
Sheppard AFB, TX	2,226	2,091	136
Shriever AFB, CO	2,345	2,403	(58)
Tinker AFB, OK	2,191	2,142	49
Travis AFB, CA	2,526	2,695	(169)
Tyndall AFB, FL	2,286	2,074	212
US Air Force Academy, CO	2,345	2,403	(58)
Vance AFB, OK	2,164	2,007	156
Vandenberg AFB, CA	2,463	2,576	(113)
Whiteman AFB, MO	2,164	2,432	(268)
Wright-Patterson AFB, OH	2,264	2,463	(199)
Standard Deviation	146	242	(96)

Table 4-5. Standard deviation for military to civilian wage difference, all occupations

Civilian Wage	Current Wage System	Proposed Wage System	Difference
Actual	10.91	10.66	0.25
Indexed	10.36	10.10	0.26

Table 4-6. Proposed wage simulation, all occupations by base

Base	Actual Eligible	Actual Reenlist	Actual Reen Rate	Actual Sqrd Dev	Proposed Total Wage Change	Predicted Reen Change	Predicted Reen Rate	Predicted Sqrd Dev
Altus AFB, OK	814	478	58.7%	0.42%	(1,459,821)	(9.2)	57.6%	0.29%
Andrews AFB, MD	1,399	756	54.0%	0.03%	728,593	4.6	54.4%	0.05%
Barksdale AFB, LA	2,448	1,329	54.3%	0.04%	(3,316,049)	(20.8)	53.4%	0.01%
Beale AFB, CA	1,419	686	48.3%	0.15%	3,163,331	19.9	49.7%	0.06%
Bolling AFB, VA	460	249	54.1%	0.04%	240,691	1.5	54.5%	0.05%
Brooks AFB, TX	343	159	46.4%	0.35%	(397,216)	(2.5)	45.6%	0.44%
Cannon AFB, NM	1,582	760	48.0%	0.18%	(1,512,435)	(9.5)	47.4%	0.23%
Charleston AFB, SC	1,722	1,025	59.5%	0.53%	(1,464,274)	(9.2)	59.0%	0.46%
Columbus AFB, MS	323	185	57.3%	0.25%	(50,500)	(0.3)	57.2%	0.24%
Davis-Mothan AFB, AZ	2,351	1,271	54.1%	0.03%	(3,025,077)	(19.0)	53.3%	0.01%
Dover AFB, DE	1,657	967	58.4%	0.37%	(355,687)	(2.2)	58.2%	0.36%
Dyess AFB, TX	2,099	1,112	53.0%	0.01%	(3,632,333)	(22.8)	51.9%	0.00%
Edwards AFB, CA	1,549	728	47.0%	0.27%	4,835,327	30.4	49.0%	0.11%
Eglin AFB, FL	2,749	1,480	53.8%	0.03%	(2,706,426)	(17.0)	53.2%	0.01%
Eielson AFB, AK	1,050	608	57.9%	0.32%	2,733,243	17.2	59.5%	0.53%
Ellsworth AFB, SD	1,445	797	55.2%	0.09%	(1,454,519)	(9.1)	54.5%	0.05%
Elmendorf AFB, AK	2,193	1,299	59.2%	0.49%	3,675,885	23.1	60.3%	0.65%
F.E. Warren AFB, WY	1,423	628	44.1%	0.66%	(1,842,241)	(11.6)	43.3%	0.79%
Fairchild AFB, WA	1,563	829	53.0%	0.01%	3,547,788	22.3	54.5%	0.05%
FT Meade, MD	885	379	42.8%	0.89%	(525,830)	(3.3)	42.5%	0.96%
Goodfellow AFB, TX	393	232	59.0%	0.46%	(669,884)	(4.2)	58.0%	0.33%
Grand Forks AFB, ND	1,573	712	45.3%	0.49%	(216,163)	(1.4)	45.2%	0.50%
Hanscom AFB, MA	430	207	48.1%	0.17%	881,016	5.5	49.4%	0.08%
Hickam AFB, HA	1,103	684	62.0%	0.96%	(1,504,746)	(9.4)	61.2%	0.80%
Hill AFB, UT	1,605	700	43.6%	0.74%	576,439	3.6	43.8%	0.70%
Holloman AFB, NM	1,684	851	50.5%	0.03%	(3,425,562)	(21.5)	49.3%	0.09%
Hurlburt Field, FL	2,655	1,494	56.3%	0.16%	(2,640,471)	(16.6)	55.6%	0.12%
Keesler AFB, MS	1,494	854	57.2%	0.24%	(2,456,879)	(15.4)	56.1%	0.15%
Kelly AFB, TX	1,206	608	50.4%	0.03%	(1,256,813)	(7.9)	49.8%	0.06%
Kirtland AFB, NM	1,226	652	53.2%	0.01%	(1,517,661)	(9.5)	52.4%	0.00%
Lackland AFB, TX	2,091	1,147	54.9%	0.07%	(2,466,053)	(15.5)	54.1%	0.04%
Langley AFB, VA	2,832	1,450	51.2%	0.01%	(2,051,145)	(12.9)	50.7%	0.02%
Laughlin AFB, TX	255	135	52.9%	0.00%	(448,267)	(2.8)	51.8%	0.00%
Little Rock AFB, AR	1,614	1,011	62.6%	1.08%	(367,634)	(2.3)	62.5%	1.05%
Los Angeles AFB, CA	138	74	53.6%	0.02%	(31,153)	(0.2)	53.5%	0.02%
Luke AFB, TX	2,189	1,142	52.2%	0.00%	138,204	0.9	52.2%	0.00%
MacDill AFB, FL	993	510	51.4%	0.01%	(713,667)	(4.5)	50.9%	0.02%
Malmstrom AFB, MT	1,468	754	51.4%	0.01%	(1,624,473)	(10.2)	50.7%	0.02%
Maxwell AFB, AL	1,060	522	49.2%	0.09%	(549,561)	(3.4)	48.9%	0.11%
McChord AFB, WA	1,476	702	47.6%	0.22%	5,208,279	32.7	49.8%	0.06%
McClellen AFB, CA	721	324	44.9%	0.53%	2,329,505	14.6	47.0%	0.28%
McConnell AFB, KS	1,041	545	52.4%	0.00%	1,438,419	9.0	53.2%	0.01%
McGuire AFB, NJ	2,054	960	46.7%	0.30%	7,001,674	44.0	48.9%	0.11%
Minot AFB, ND	1,898	936	49.3%	0.09%	(586,203)	(3.7)	49.1%	0.10%

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Table 4-6. Continued

Base	Actual Eligible	Actual Reenlist	Actual Reen Rate	Actual Sqrd Dev	Proposed Total Wage Change	Predicted Reen Change	Predicted Reen Rate	Predicted Sqrd Dev
Moody AFB, GA	1,594	780	48.9%	0.11%	(455,989)	(2.9)	48.8%	0.12%
Mountain Home AFB, ID	1,787	781	43.7%	0.73%	1,126,086	7.1	44.1%	0.66%
Nellis AFB, NV	2,946	1,446	49.1%	0.10%	3,799,571	23.9	49.9%	0.05%
Offutt AFB, NE	2,831	1,547	54.6%	0.06%	1,463,301	9.2	55.0%	0.07%
Patrick AFB, FL	537	294	54.7%	0.06%	(335,041)	(2.1)	54.4%	0.05%
Pentagon, DC	271	122	45.0%	0.52%	131,947	0.8	45.3%	0.48%
Peterson AFB, CO	1,278	576	45.1%	0.51%	734,123	4.6	45.4%	0.46%
Pope AFB, NC	1,863	1,020	54.8%	0.06%	(2,118,339)	(13.3)	54.0%	0.03%
Randolph AFB, TX	793	448	56.5%	0.18%	(896,101)	(5.6)	55.8%	0.13%
Robins AFB, GA	1,257	701	55.8%	0.12%	(1,362,788)	(8.6)	55.1%	0.08%
Scott AFB, IL	1,478	765	51.8%	0.00%	3,540,318	22.2	53.3%	0.01%
Seymour Johnson AFB, NC	2,045	1,101	53.8%	0.03%	(4,012,284)	(25.2)	52.6%	0.00%
Shaw AFB, SC	2,494	1,274	51.1%	0.01%	(3,178,283)	(20.0)	50.3%	0.04%
Sheppard AFB, TX	661	404	61.1%	0.79%	(897,821)	(5.6)	60.3%	0.65%
Shriever AFB, CO	822	373	45.4%	0.47%	473,146	3.0	45.7%	0.42%
Tinker AFB, OK	2,715	1,416	52.2%	0.00%	(1,248,731)	(7.8)	51.9%	0.00%
Travis AFB, CA	3,137	1,658	52.9%	0.00%	6,066,919	38.1	54.1%	0.03%
Tyndall AFB, FL	1,261	675	53.5%	0.02%	(2,607,411)	(16.4)	52.2%	0.00%
US Air Force Academy, CO	413	208	50.4%	0.04%	235,935	1.5	50.7%	0.02%
Vance AFB, OK	141	77	54.6%	0.06%	(225,062)	(1.4)	53.6%	0.02%
Vandenberg AFB, CA	964	457	47.4%	0.23%	1,292,769	8.1	48.2%	0.16%
Whiteman AFB, MO	1,287	692	53.8%	0.02%	3,580,297	22.5	55.5%	0.11%
Wright-Patterson AFB, OH	1,306	689	52.8%	0.00%	2,663,787	16.7	54.0%	0.03%
Total	96,554	50,435	52.2%	15.00%	(0)	(0.0)	52.2%	13.64%

Table 4-7. Proposed wage simulation, selected occupations

Occupation	Actual Eligible	Actual Reenlist	Actual Reen Rate	Actual Sqrd Dev	Proposed Total Wage Change	Predicted Reen Change	Predicted Reen Rate	Predicted Sqrd Dev
Aviation Maintenance	21,918	11,553	52.7%	180.0%	308,495	1.9	52.7%	177.4%
Civil Engineering	7,283	3,130	43.0%	26.6%	786,530	4.9	43.0%	25.5%
Security Forces	9,330	3,549	38.0%	37.8%	(642,624)	(4.0)	38.0%	34.2%

CHAPTER 5
CONCLUSIONS

This dissertation analyzed military pay policy and the effects on Air Force retention. The study explored the distributive effects from a 1998 policy, which changed the methodology for computing military housing allowances. Additionally, the study analyzed the local labor market wage effects on Air Force first-term reenlistments. Finally, an alternative wage structure was proposed to replace the housing allowance system.

Results from analyzing the DoD's BAH policy change showed that housing allowances increased in most locations and ranks, but significant differential policy effects were evident. Some of these effects were expected. However, increased allowances in locations voting Democratic in the 1996 presidential election cannot be reasonably attributed to the DoD's goals. Estimates for allowance increases associated with a 1 standard deviation increase from the mean in the % Democratic vote ranged from 0.99% to 3.42%.

Next, results from analyzing the military and civilian wages across locations showed that military wages are not in equilibrium with local civilian labor markets. The cost-of-living elasticity of military wages was shown to be significantly less than that for civilian wages; and military wages are not adjusted for location amenities. The result is an inequitable distribution of military wages across locations. This inequity was shown

to significantly affect the reenlistment decision of Air Force first-term personnel from 1996-2001.

Finally, the study proposed an alternative wage structure to replace the current system. Analysis shows that the current system leads to production inefficiencies caused by short-term manning shortages in excessively high-turnover locations. Additionally, because wages are not set at the level required to induce enough volunteers to serve in each location, the total opportunity cost for personnel serving is not minimized. The solution is to set military wages according to the local civilian compensating wage differentials. Wages set accordingly would result in a more stabilized force, by equalizing the opportunity costs at each location. Simulations showed that the proposed wage structure would better equalize reenlistment rates across locations, and this could be at no cost to the government.

APPENDIX A
SUMMARY STATISTICS

Table A-1. Chapter 2 summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Basic Allowance for Housing (BAH) (dollars)	31,291	864.07	300.98	389.00	3,441.00
Fair Market Rent, (FMR) (dollars)	31,291	574.73	154.62	343.00	1,747.00
Population (millions)	31,291	0.68	1.70	0.01	21.36
Military Personnel Assigned (thousands)	30,901	2.14	5.53	0.02	60.02
% Democratic Vote, Local	31,291	46.29	8.48	18.70	85.19
% Democratic Vote, State	31,291	48.00	6.34	33.27	85.19
BAH Change, ln(BAH01/BAH96)	4,017	0.21	0.15	-0.15	1.00
Cost Change, ln(FMR01/FMR96)	4,017	0.11	0.07	-0.15	0.43
Adjustment, ln(BAH96/FMR96)	4,017	0.34	0.27	-0.53	1.09
BAH (1996)	4,069	770.43	234.51	390.00	1,730.90
BAH (1997)	4,056	805.36	240.04	408.00	1,821.21
BAH (1998)	4,056	821.38	246.82	419.40	1,836.92
BAH (1999)	4,810	815.02	247.90	389.00	2,084.00
BAH (2000)	4,810	856.34	282.17	393.00	2,383.00
BAH (2001)	4,745	939.07	337.87	393.00	2,975.00
BAH (2002)	4,745	1,013.59	386.47	426.00	3,441.00
BAH (E-4)	2,407	581.92	180.64	389.00	2,153.00
BAH (E-5)	2,407	651.70	193.59	434.00	2,332.00
BAH (E-6	2,407	728.93	216.94	476.00	2,656.00
BAH (E-7)	2,407	788.32	225.16	515.00	2,731.00
BAH (E-8)	2,407	845.24	235.01	554.00	2,814.00
BAH (E-9)	2,407	916.50	245.87	599.00	2,946.00
BAH (O-1)	2,407	669.03	197.88	448.00	2,369.00
BAH (O-2)	2,407	745.84	215.01	504.00	2,649.00
BAH (O-3)	2,407	870.11	247.14	586.00	2,861.00
BAH (O-4)	2,407	1,008.20	263.84	710.00	3,162.00
BAH (O-5)	2,407	1,115.50	273.87	810.00	3,374.00
BAH (O-6)	2,407	1,135.83	273.45	843.00	3,402.00
BAH (O-7)	2,407	1,175.75	264.02	946.00	3,441.00

Table A-2. Chapter 3 summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Reenlistment	96,554	0.52	0.50	0	1
Military Wage, Local (Annualized PV 4-year reenlistment)	96,554	25,033.54	3,452.10	20,608.55	40,120.00
Civilian Wage, Local Actual (Annualized PV of 4-year wage)	75,665	36,370.48	11,578.60	12,922.12	99,397.57
Civilian Wage, Local Indexed (Annualized PV of 4-year wage)	96,554	36,828.88	10,902.71	14,945.67	100,373.30
Civilian Wage, National (Annualized PV of 4-year wage)	96,554	39,262.75	10,986.22	18,703.09	87,022.15
ACOL, Average (thousands) (Avg Military - Civilian, National)	96,554	(14.21)	10.40	(52.96)	8.73
Local - National (thousands) (Military Wage)	96,554	(0.01)	1.35	(3.25)	5.58
Local - National (thousands) (Actual Civilian Wage)	75,665	(2.54)	6.91	(45.33)	38.35
Local - National (thousands) (Indexed Civilian Wage)	96,554	(2.43)	3.93	(17.48)	13.35
ACOL, Local (Actual Civilian Wage) (Military Wage - Civilian Wage)	75,665	(11.41)	10.86	(70.09)	14.57
ACOL, Local (Indexed Civilian Wage) (Military Wage - Civilian Wage)	96,554	(11.80)	10.13	(63.30)	10.23
Unemployment, Local	96,554	4.33	1.68	2.10	15.38
Price Level (Total)	91,743	1.05	0.12	0.85	1.50
Price Level (Housing and Utilities)	91,743	1.01	0.06	0.91	1.25
Price Level (All Other Goods)	91,743	1.05	0.07	0.91	1.31
January Average Temperature (Fahrenheit)	96,554	38.49	12.61	4.30	71.40

APPENDIX B
PRE-TRUNCATION DATA EXAMPLES

Table B-1. Pre-truncation data examples

Location	State	1999 Allowance	2000 Allowance	2000 pre-truncation	2001 Allowance	2001 pre-truncation[1]
Tuscaloosa	AL	506	506	455	506	506
San Fransisco	CA	933	1129	1129	2042	2042
Fresno	CA	502	502	441	502	496
San Bernadino	CA	582	582	469	643	643
Minot AFB	ND	393	393	313	393	352
Cannon AFB (Clovis)	NM	426	426	347	426	390
Nellis AFB (Los Vegas)	NV	692	692	660	731	731
New York	NY	769	937	937	1315	1315
Hill AFB (Ogden)	UT	563	563	483	563	543
Hampton/Newport News	VA	532	532	503	624	624

[1] The 2001 pre-truncation allowances were estimated by by multiplying the 2000 pre-truncation allowance by 1.1244. This allowance replaced the actual allowance only where there was not an upward adjustment in the actual 2000-2001 allowance and if this estimate was less than the actual

APPENDIX C
PROBIT AND LINEAR COMPARISON

Table C-1. Probit and linear model comparison

Variable	ACOL		Unemp	
Model	Probit	linear	Probit	linear
Coefficient	0.0012770	0.0012766	0.0028847	0.0028853
Standard error	0.0003598	0.0003597	0.0026249	0.0026239
Observations	75,665	75,665	75,665	75,665
Difference in coefficients	0.0000004		-0.0000006	

APPENDIX D
CONDITIONAL FIXED EFFECTS LOGISTIC MODEL RESULTS

Table D-1. Conditional fixed effects logistic model results

Var/Spec	1	2	3
ACOL	0.0096***	0.0037**	0.0265***
(Local)	(0.0016)	(0.0018)	(0.0032)
Unemployment	-0.0071	0.0388**	-0.0031
(Local)	(0.0057)	(0.0196)	(0.0046)
Log Likelihood	-40,624	-40,499	-52,917
R-Sqr	0.0005	0.0036	0.0007
Observations	72,257	72,257	92,839
Local Civilian Wage	Actual	Actual	Indexed
Fixed Effects[1]	1	1,2[2]	1

[1] Fixed Effects: 1=AFSC by Command by Year, 2=Base

[2] The base fixed-effect is unconditioned.

APPENDIX E
AIR FORCE BASE LOCATIONS

Table E-1. Air Force base locations

Base	Location	OES Metropoitan Area	Distance (miles)
Altus AFB, OK	Altus, OK	Lawton, OK	56
Andrews AFB, MD	Washington, DC	Washington, DC	0
Barksdale AFB, LA	Shreveport, LA	Shreveport-Bossier City, LA	0
Beale AFB, CA	Yuba County, CA	Yuba City, CA	0
Bolling AFB, VA	Washington, DC	Washington, DC	0
Brooks AFB, TX	San Antonio,TX	San Antonio, TX	0
Cannon AFB, NM	Clovis, NM	Lubbock, TX	100
Charleston AFB, SC	Charleston, SC	Charleston-North Charleston, SC	0
Columbus AFB, MS	Columbus, MS	Jackson, MS	174
Davis-Mothan AFB, AZ	Tucson, AZ	Tucson, AZ	0
Dover AFB, DE	Dover, DE	Dover, DE	0
Dyess AFB, TX	Abilene, TX	Abilene, TX	0
Edwards AFB, CA	L.A. Cty/Kern Cty/Mohave Cty, CA	Los Angeles-Long Beach, CA	0
Eglin AFB, FL	Fort Walton Beach, FL	Fort Walton Beach, FL	0
Eielson AFB, AK	Fairbanks, AK	Anchorage, AK	354
Ellsworth AFB, SD	Rapid City, SD	Rapid City, SD	0
Elmendorf AFB, AK	Anchorage, AK	Anchorage, AK	0
F.E. Warren AFB, WY	Cheyenne, WY	Cheyenne, WY	0
Fairchild AFB, WA	Spokane, WA	Spokane, WA	0
FT Meade, MD	Baltimore, MD	Baltimore, MD	0
Goodfellow AFB, TX	San Angelo, TX	San Angelo, TX	0
Grand Forks AFB, ND	Grand Forks, ND	Grand Forks, ND	0
Hanscom AFB, MA	Boston, MA	Boston, MA	0
Hickam AFB, HA	Honolulu, HI	Honolulu, HI	0
Hill AFB, UT	Ogden, UT	Salt Lake City, UT	0
Holloman AFB, NM	Alamagordo, NM	Las Cruces, NM	68
Hurlburt Field, FL	Fort Walton Beach, FL	Fort Walton Beach, FL	0
Keesler AFB, MS	Biloxi, MS	Biloxi-Gulfport-Pascagoula, MS	0
Kelly AFB, TX	San Antonio, TX	San Antonio, TX	0
Kirtland AFB, NM	Albuquerque, NM	Albuquerque, NM	0
Lackland AFB, TX	San Antonio, TX	San Antonio, TX	0
Langley AFB, VA	Hampton, VA	Norfolk, VA	0
Laughlin AFB, TX	Del Rio, TX	San Angelo, TX	156
Little Rock AFB, AR	Little Rock, AK	Little Rock-North Little Rock, AK	0
Los Angeles AFB, CA	Los Angeles, CA	Los Angeles-Long Beach, CA	0
Luke AFB, TX	Phoenix, AZ	Phoenix-Mesa, AZ	0

(continued next page)

Table E-1. Continued

Base	Location	OES Metropoitan Area	Distance (miles)
MacDill AFB, FL	Tampa, CA	Tampa-St. Petersburg-Clearwater, FL	0
Malmstrom AFB, MT	Great Falls, MT	Great Falls, MT	0
Maxwell AFB, AL	Montgomery, AL	Montgomery, AL	0
McChord AFB, WA	Tacoma, WA	Tacoma, WA	0
McClellen AFB, CA	Sacramento, CA	Sacramento, CA	0
McConnell AFB, KS	Wichita, KS	Wichita, KS	0
McGuire AFB, NJ	Trenton, NJ	Trenton, NJ	0
Minot AFB, ND	Minot, ND	Bismark, ND	110
Moody AFB, GA	Valdosta, GA	Albany, GA	89
Mountain Home AFB, ID	Mountain Home, ID	Boise, ID	44
Nellis AFB, NV	Las Vegas, NV	Las Vegas, NV	0
Offutt AFB, NE	Omaha, NE	Omaha, NE	0
Patrick AFB, FL	Cape Canaveral, FL	Melbourne, FL	0
Pentagon, DC	Washington, DC	Washington, DC	0
Peterson AFB, CO	Colorado Springs, CO	Colorado Springs, CO	0
Pope AFB, NC	Fayetteville, NC	Fayetteville, NC	0
Randolph AFB, TX	San Antonio, TX	San Antonio, TX	0
Robins AFB, GA	Macon, GA	Macon, GA	0
Scott AFB, IL	O'Fallon, IL	St Louis, MO	0
Seymour Johnson AFB, NC	Goldsboro, NC	Goldsboro, NC	0
Shaw AFB, SC	Sumter, SC	Sumter, SC	0
Sheppard AFB, TX	Wichita Falls, TX	Wichita Falls, TX	0
Shriever AFB, CO	Colorado Springs, CO	Colorado Springs, CO	0
Tinker AFB, OK	Oklahoma City, OK	Oklahoma City, OK	0
Travis AFB, CA	Fairfield, CA	Vallejo-Fairfield-Napa, CA	0
Tyndall AFB, FL	Panama City, FL	Panama City, FL	0
US Air Force Academy, CO	Colorado Springs, CO	Colorado Springs, CO	0
Vance AFB, OK	Enid, OK	Enid, OK	0
Vandenberg AFB, CA	San Luis Obispo Cty/Sonoma Cty, CA	San Luis Obispo, CA	0
Whiteman AFB, MO	Johnson, County	Kansas City, MO	0
Wright-Patterson AFB, OH	Dayton, OH	Dayton-Springfield, OH	0

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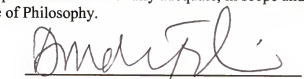
BIOGRAPHICAL SKETCH

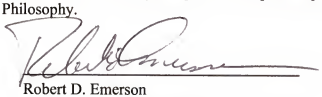
I was born and raised in Keokuk, Iowa. I graduated from Keokuk Senior High School in 1991; and from the United States Air Force Academy in 1995, with a Bachelor of Science in economics. Additionally, I graduated with a Master of Science degree in management and a Master of Arts degree in economics from the University of Florida in May 2002. I was commissioned as a Second Lieutenant in the United States Air Force in May 1995, promoted to First Lieutenant in 1997, and to Captain in 1999. My Air Force assignments include Deputy Budget Officer, 6th Air Refueling Wing, MacDill Air Force Base Florida; and Commander Financial Analysis Flight, Seymour Johnson Air Force Base, North Carolina. After graduation I will be assigned to the United States Air Force Academy as instructor in the economics department. I am married to the former Susan Marcinkowski of Keokuk, Iowa. We have two sons, Zachary and Luke.

I certify that I have read this study and that in my opinion is conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the Doctorate of Philosophy.



David N. Figlio, Chair
Associate Professor of Economics

I certify that I have read this study and that in my opinion is conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the Doctor of Philosophy.



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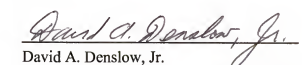

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This dissertation was submitted to the Graduate Faculty of the Department of Economics in the College of Business Administration and to the Gradate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 2003

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Dean, Graduate School